This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

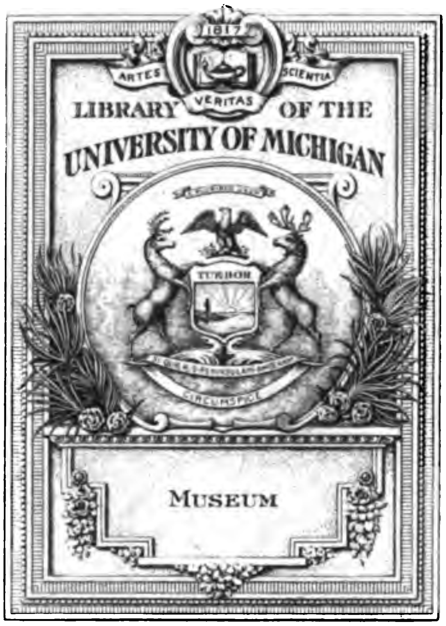
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

AN

UST


1817
ARTES
VERITAS
SCIENTIA
TUEBOR
CIRCUMSPICE

THE

AMERICAN NATURALIST,

An Illustrated Magazine

OF

NATURAL HISTORY.

EDITED BY

EDWARD D. COPE AND J. S. KINGSLEY,

ASSISTED BY

DR. C. O. WHITMAN, DR. C. E. BESSEY, THOMAS WILSON, PROF. C. M. WEED, PROF. W. S. BAYLEY, PROF. E. A. ANDREWS.

VOLUME XXVIII.

PHILADELPHIA, U. S. A.

THE EDWARDS & DOCKER CO.,

518 AND 520 MINOR STREET.

1894.

CONTENTS.

LEADING ARTICLES:

INDEX.

THE

AMERICAN NATURALIST

VOL. XXVIII. January, 1894. 325

CRITICISM OF SOME CASES OF APPARENT TRANSMISSION OF MUTILATIONS.[1]

TRANSLATED FROM THE GERMAN OF DR. O. VOM RATH.

Whenever a discussion arises as to whether characters acquired in the life of the individual are transmitted, first of all is ordinarily put the special question[2] whether the transmission of mutilations may be admitted. In various papers Weismann (32) has shown that the previously known cases of alleged transmission of mutilations do not hold their ground before careful criticism, and are far from serving as indisputable proof. In the judgment of such cases so much greater care is necessary, since it is often very difficult to decide

---

[1] TRANSLATOR'S NOTE.—This article appeared originally in the Berichte der Naturforschenden Gesellschaft zu Freiburg, i. Bn., Bd. VI, Heft 3, and was reprinted in the Biologisches Centralblatt, Bd. XIII, No. 3, p. 65–76, from which it was translated. Especially in its striking proof of the necessity of extreme care in sifting and testing evidence, it forms a most valuable contribution to the literature of a subject which, perhaps, more than most others, has been marked by failure to apply sharply the scientific method.—*Henry B. Ward, University of Nebraska, Lincoln.*

[2] The special question of the transmission of mutilations is of the greatest importance, since a single case of such transmission, if entirely beyond question, would be sufficient to decide finally *the entire matter of the inheritance of acquired characters*, since, in that case, the possibility of the transmission of all characters acquired in the lifetime of the individual, in physical as well as intellectual relations, would also have to be granted. By the by, I should like to mention just here, that at present some authors, and with them a part of the educated laity, are inclined to deny the transmission of single injuries or mutilations, but, on the other hand, to look upon the transmission of acquired characters upon the whole as possible.

whether the abnormality present in the paternal or maternal individual was actually caused by some external interference, or arose as an inborn (blastogenic) variation of the germ. Of those authors who deny the transmission of acquired characters, the pathologist, E. Ziegler (35), approaches most closely to the Weismannian point of view, and his valuable papers in which he discusses the most recent articles on inheritance and the doctrine of descent and their importance for pathology, form important supplements to the writings of Weismann. Among other things, E. Ziegler emphasizes the fact "that pathological characters acquired in the life of the individual are not transmitted, and that the first origin of transmissable diseases and mutilations is not to be sought in the acquirement of corresponding changes during the life of one of the parents, but in variations of the germ."

It is by no means my intention to go into the extensive literature on this point.[3] The purpose of my article is rather to communicate some interesting cases of apparent transmission of mutilations, which I learned of by personal experience, and was able to test carefully. If even now some of these cases do not permit a definite decision, still it may not be useless to recount them here, since, by just such examples which, at first glance, let no doubt of the fact of such transmission appear, it can best be shown with what extreme care an unpartisan observer must prove the true character of the case, and pass judgment upon it.

Before beginning my description, let me call attention to the fact that the expression "acquired character" has been used by different authors often in a very different sense. Weismann has expressed himself on this point as follows: "Since the term *acquired character* is not taken by all the in sharply circumscribed sense in which it is used by zoologists and botanists, I propose, in cases where a misunderstanding is possible, to use,

---

[3] I refer especially to the important papers in the appended list, those of Weismann (32), Ziegler (35), Eimer (9), Kölliker (16), Virchow (28), Claus (5) and others. In passing, I should like to call to mind the fact that two years ago the question of the inheritance of acquired characters was discussed clearly and pregnantly by van Bemmelen (1), in a historical critical investigation, with reference to the standpoint taken by Weismann, and with a review of the most important literature.

instead of *acquired*, the word *somatogenic*, i. e., proceeding from the body—*soma*—in contrast to the germ substance, and to designate such characters as proceed from the composition of the germ as blastogenic. If a man's finger is cut off, his tetradactyl condition is a somatogenic or acquired character; if, on the other hand, a child is born with six fingers, this condition must have proceeded from the peculiar constitution of the germ substance.[4] It is therefore a blastogenic character." In this description I shall adhere to Weismann's form of expression.

The facts of the first case are as follows: In a family closely related to myself was kept a pair of dogs (terriers), faultless in every particular; both dog and slut were known to have had fully normal parents, and on their part to have produced, in several litters, normal young. By an unfortunate fall, the dog suffered a break in the upper part of the right humerus, as a result of which, even to-day, there remains a peculiar posture of the damaged extremity, connected with continued limping. In the next litter, which followed some time after the complete recovery of the father, were three young, two dogs and a slut. The fully normal young slut died soon after birth. Shortly thereafter, the mother came to her end also. Of the two young

---

[4] The question whether such a sharp fundamental difference as Weismann emphasizes can be made between germ and body cells, so that every trace of germ plasm is wanting in the somatic cells, has been answered in varying manner by different authors, and, for example, is distinctly denied by Kölliker (16). That moreover, among the lower plants the difference between somatic and propagating cells may be very small, has been pointed out by Weismann himself (Biol. Centr. X, No. 1–2). "DeVries (29), the noted botanist, has pointed out that certain constituents of the cell-body, e. g., the chromatophores of the algæ are transmitted directly from the egg-cell of the mother to the daughter organism, while the male germ-cells ordinarily contain no chromatophores. Here then, the inheritance of somatogenic variations would be, it seems, possible. Yet, just in the lower plants, the difference between somatic and propogating cells is still slight, and the body of the egg-cell does not need to undergo a complete transformation in chemical and structural respects when it develops into the body of the somatic cells of the daughter individual. But what has that to do with the problem whether, for instance, the pianist can transmit to his descendants the strength of digital muscles acquired by practice. How does this result of his practice reach the germ-cells? Therein lies the riddle which they have to solve who maintain the transmission of somatogenic charaacters." For our purpose, however, this special question comes less into consideration since one may regard the question of the transmission of acquired characters for the present, as a purely empirical one.

dogs, the one was in every respect normally formed, and in color and form the true likeness of the mother, whereas the other dog not only resembled exactly the father, but also like him possessed an abnormally placed right fore leg, and continually limped with this leg from birth up to to-day, when the animal has long since reached full growth. At the sight of the dog, all eye-witnesses were completely convinced of the fact of the transmission of a former injury.

As will be easily understood, my attention was at once directed to establishing whether the peculiarities in question really corresponded exactly in father and son. To begin with, I found that after the fall, the right fore-leg of the father was essentially different from the left, and had remained so constantly, and that the animal continually limped on this leg, and always in the same way. A certain weakness and great tenderness is noticeable even to-day in the entire shoulder region, and especially at the spot at which the injury took place; the entire musculature on the humerus is also strikingly degenerate. The position of the injured leg (especially from elbow joint down) differs in a curious way from that of the uninjured left leg. The entire extremity has a fully crippled appearance. The apparently shortened forearm and foot of the right foreleg assume unmistakably a bow-legged position, and the entire extremity is strikingly bent inward.

The investigation of the limping young dog showed the following: In spite of careful feeling I could find on the right foreleg neither a sensitive place nor an abnormity of humerus or of the musculature; on the contrary, the right foreleg is externally completely similar to the left, but unquestionably different in posture and shape from the latter. While now in the father the right leg is "O"-shaped (bow-legged), and the foot is turned inward, the corresponding leg of the young dog shows exactly the reverse tendency in posture. It is rather "X"-shaped ("knock-kneed") and the foot is turned outward, but by no means so much as the corresponding foot of the father turns inward. The difference in the posture of the leg does not strike one so much when the two young dogs are observed together as when the father and the limping one are

compared along side of each other. In the usually very active movement of the animals, moreover, the difference in the posture of the legs does not become so evident as when the animals move slowly or stand still.

In judging this case it is to be noted, first of all, that the abnormality of the young dog which might be regarded as inherited (transmitted), does not agree in many particulars, especially in regard to the posture of the leg, with the acquired deformity of the father. There is, as it appears to me, a double interpretation of the case possible. Either one may assume that the abnormality of the young dog has appeared without any inheritance as a germ variation, which is not further traceable to its causes, and that a case of transmission has only apparently arisen, since by chance the paternal animal showed an acquired abnormality of the same leg as that on which, in the young animal, an abnormality arose by variation; or, on the other hand, one may regard the acquired abnormality of the paternal animal as the cause of the congenital abnormality of the young dog; in the latter event, it must be carefully noticed that the inherited peculiarity is very little similar to the original. Hence, there would be present only a certain influence, but not such a transmission as we perceived in the case of individual variations (blastogenic changes) in which the transmitted peculiarity differs, perhaps, in degree from the transmitting, but is always like it.

As far as the limping of the two dogs is concerned, I do not think that further significance can be attributed to this circumstance. To be sure, both dogs limp on the same leg—the father always alike, the son sometimes more and sometimes less, and often scarcely noticeably; thereby is by no means proved that the same cause lies at the bottom of the limping of both animals. As is well-known, quadrupeds, and especially dogs and horses, limp in consequence of the most varied causes, and it is often very difficult to find the real ground of the linping. In the case described, the limp of the father is evidently the result of the fall. I was as little successful as other investigators in finding the true reason of the trouble in the son, since nowhere on the entire body was a tender spot to be discovered.

The following case is so simple and characteristic, that no doubt can exist as to its interpretation. A Mr. S., a perfectly normal and well-proportioned man, had from youth up, the habit of turning the tip of his right foot outward more than that of the left, a circumstance which was especially apparent in dancing, and also showed prominently in foot-prints left in the snow or on moist ground. This peculiarity all his children (three sons) have inherited, only with the difference that in one of them, besides the right, the left foot also is turned out in a like striking manner. Since now the father of Mr. S., as a young man, acquired, in consequence of an apoplectic fit, apparent lameness of the right leg, as a result of which this leg was dragged behind, with the foot strikingly turned outward, one concluded that the peculiarity of the out-turned foot inherited from the older Mr. S. (i. e., a somatogenic character) had been transmitted to his son, and in still stronger measure to his grandchildren. As I stand in close connection with the family concerned, it was easy for me to acquire the necessary information, and I was able to establish the fact that the younger Mr. S. was already several years old when his father suffered the stroke, and further, that the elder Mr. S., from youth up, had complained of a certain weakness in the right leg, and that an important deterioration in the condition of the entire leg appeared directly after the stroke. If now one wishes to bring the out-turned foot of the younger Mr. S. in connection with the infirmity of his father, a thing which, according to my view, is not at all necessary, then it can be regarded as an inherited peculiarity in both the father and the son, i. e., a blastogenic, but by no means a somatogenic character. Such habits of peculiar postures of the foot not infrequently appear suddenly and without visible cause in some person or other, without a similar case having been known in the family of the same person. I also know a man who, from youth up, had the habit of continually turning the right foot in a striking manner inward, so that it was jocosely said of him he had two left feet; but neither in parents, brothers, children, nor other relatives of the man, has ever been noticed any special inclination to a striking position of the foot.

The third case which I shall now report came to my knowledge as in my own family, in consequence of the instance just described, the question of the transmission of mutilations was actively discussed. In that connection, this case was held up to me as an absolutely trustworthy proof of the possibility, yes, of the fact of such a transmission. The case is the more interesting since it is concerned with the apparent transmission of a scar [" Schmiss "—the term applied to the duelling scars of the German students.—*Trans.*].

A Mr. H. had received, as a student, a serious saber cut, extending vertically along his right cheek, and had retained, during his entire life, the conspicuous scar. Since one of the children of the gentleman, a daughter, brought into the world, exactly on the same spot of the right cheek, a birth-mark in form of a fine red slash, the length of the father's scar, no one hesitated to bring this birth-mark into genetic connection with the cut of the father; and since, in addition, among the five children of this lady, one son also possessed from birth an equally long birth-mark, exactly on the same spot as that of his mother, no one doubted an instant that the scar of the grandfather, an acquired (somatogenic) character had been transmitted to the daughter and the grandchild. Now so convincing as indeed this case appears at first glance, it is yet very far removed from furnishing actually indisputable proof of the transmission of mutilations.

In the first place, I should not neglect to mention that I have known the family in question for many years, without the peculiar inherited birth-mark of the lady or her son ever having attracted my attention, until I was called to notice, and could confirm its actual existence. With the lady, as with her son, the characteristic family mark had been very prominent in the early years of life, it then faded gradually, without disappearing completely, however. The elder Mrs. H., grandmother of the young man, is still living, and, according to her own account, has never possessed such a birth-mark on her right cheek; at present, every trace of one is certainly lacking, so that one is inclined to think of a transmission from the side of the grandfather, the elder Mr. H. Unfortunately, this gen-

tleman died many years ago, and it was on that account impossible for me to determine whether he also did not possess from his birth, such a mark on his right cheek, the existence of which was gradually forgotten,[5] especially, as on this cheek, the large scar and a number of smaller cuts were added.

Besides this possibility, there ought not to be left out of consideration the fact that not infrequently peculiar birth-marks are brought into the world by children, without the same or similar marks ever having been observed in the family in question or among relatives. That sometime such a mark could appear in some child exactly on the spot on which the father had had a cut, is, of itself, nothing surprising, or indeed strange. In a like sense Weismann has already expressed himself, before, indeed, such a case of apparent transmission of a scar had come to light. "I, indeed, do not wish to doubt," says Weismann, "that among the many thousand students whose faces are adorned by so-called cuts, one could be found sometime whose son has a birth-mark on the precise place on which the scar of the father is found. There exist many kinds of birth-marks; why not sometime, then, one exactly on the position and exactly in the form of a scar. Then we would have here a case such as the adherents of the doctrine of the

---

[5] How easily such birthmarks, especially if prominent only in early childhood, come to be forgotten, may be seen from the following incident: The young man in question, who, like his grandfather, fought left-handed, and has also carried off a considerable number of cuts on his right cheek and forehead, is now father of two children, who show no trace of the family mark. The young wife of the gentleman, whom, as a relative, I have known from early childhood, brought into the world on her brow and scalp a red mark, about 6 cm. long, whereas, among grandparents, parents, sisters and other relatives, such a birth-mark has never appeared. Gradually it has grown rather indistinct, and has come to be forgotten, especially since the "bang" of the child was combed down over the naturally peculiarly high brow. I have convinced myself personally that neither the brother nor sisters of the young wife, nor her husband and other connections, had a suspicion of the existence of the mark. Yes, that she herself knew nothing of it, and could be convinced of the actual presence of this mark only by the assurance of her mother who confirmed my indiscreet statements. At present, moreover, only a very weak, scarcely perceptible trace of this mark is to be recognized. If a child of this couple had brought into the world any birth-mark whatsoever upon the brow, this mark surely would have been brought in genetic connection with one of the cuts on the forehead of the father, since the congenital mark on the mother's brow had long since lapsed into forgetfulness. One would then, with great probability, have spoken falsely of the transmission of a scar.

transmission of acquired characters have long wished, a case of which they think that it alone would suffice to overthrow the entire structure of their opponents. But how far, then, would such a case, if it were really authenticated, be more in position to establish the kind of transmission asserted than the case related by v. Baer, the claim of *Versehen*[6]? I think there lies in the very extraordinary rarity of such cases, a strong indication that there is concerned an accidental, not a causal, occurrence. If cuts could really be transmitted, we should have to expect to meet very often such birth-marks corresponding to the paternal scar, in nearly all such cases, namely, in which the son inherited the features of the father."

From the preceding description we have seen that the apparently so convincing cases of the transmission of former injuries, which I have described, surely do not speak in favor of this theory, which requires nothing less than unimpeachable proof; they accord in part with the cases discussed by Weismann, in which direct proof could be furnished that the peculiarities in

---

[6] In passing, I should like to mention how prevalent the belief in the *Versehen* of pregnant women still even in so-called educated circles, and should like to relate, only as a curiosity, the following case which occurred also in a family of acquaintances. A Mr. X. went driving with his daughter, who was in the fourth month of pregnancy. By an unlucky chance the pet dog of the young wife fell under the wheels, and was terribly mangled. At the sight of the bleeding animal the horrified woman made involuntarily a movement of the right hand towards the *Kreuzgegend* and behold the timely born, completely normal child, had on the same region a large blood-red spot. Mr. X. assured me that neither in his family nor in that of his wife had a similar birth-mark ever appeared, and so all were agreed that this red mark of the child must stand in direct relation to the movement of the mother at the sight of the bleeding dog. I could only express to the family my warmest congratulations that the young wife possessed such great presence of mind, joined to tender motherly love, that she made the motion of the hand towards just that region, for if, as is wont to be the rule at horrible spectacles, she had covered her eyes with her hand, then the child would have had to bring into the world a peculiar facial ornament, something in the line of a blood-red nose. To go further into detail with regard to the impossibility of the *Versehen* of pregnant women, I regard as superfluous. It is sufficiently well-known that from the moment of the fertilization of the egg by the spermatozöon, the fate of the embryo is decided, both so far as its form as well as its individual *Anlagen* are concerned. Naturally, on account of the intimate connnection of the fruit with the mother, sickness which affects the entire organism of the latter, will also work detrimentally to the embryo, but neither beautiful nor horrible appearances on the part of the pregnant can produce the slightest change in the form of the embryo.

question do not at all correspond in the child and in the father or mother (parent, Weismann), and stand in no genetic connection.

The arguments which oppose the acceptance of the theory of the inheritance of mutilations, have been discussed so much in detail, especially by Weisman and Ziegler, that I shall not refer further to them here. The objections raised have by no means grown weaker of late; they have rather been considerably strengthened by new investigations which give us a deeper insight into the character and processes of fertilization (Weismann's Amphimixis). If now there is no doubt that in the acceptance of the transmission of mutilations, and of the other peculiarities acquired in the life of the individual, the phenomena of the theory of descent find a convenient and simple explanation, this condition by no means authorizes us to an unconditional acceptance of this supposition, since, as Weismann has shown, all phenomena of the theory of descent may also be explained just as simply and unconstrainedly without the aid of the Lamarckian principle. Of special importance for the decision of the question at issue are Weismann's much discussed experiments on mice. As is known, the artificial mutilations of these animals were carried on in both parents through many generations, without any apparent success. Similar recently published experiments of Ritzema Bos, as well as those of J. Rosenthal, showed also the same negative result. If now indeed these experiments on mice, as Weismann states with especial emphasis, alone and without further evidence, by no means furnish direct proof of the claim "that injuries cannot at all be transmitted, since such experiments must be prosecuted even to infinity: yet, indeed, after these unanimously negative results, the possibility of the transmission of single mutilations can be put entirely aside, and the [inheritance of?—*Trans.*] mutilations repeated on both parents through many generations, appear at least very improbable. I, as little as Weismann, Ziegler, and others, desire to doubt that modifying influence of external interference and stimulus on the germ plasm. One can be easily convinced of this, that change of climate, altered conditions of temperature, light and

moisture, different manner of nourishment, transform entirely unmistabably the organism of plant and animal, and there is nothing in the way of the opinion that by the continued working of such external influences and stimuli the molecular structure of the germ plasm also experiences a change which can lead to a transmission of the transformations. Above all, it ought not to be forgotten in this case that the somatic cells are in no way the first to be modified by the stimulus, and that then by some sort of unexplained process (Pangenesis, or intracellular pangenesis) this stimulus is transmitted gradually by these cells to the plasma of the germ cells. The influence on the germ plasm is rather a direct one, and if, by continued influence, a transformation of the structure of this plasm takes place and transmission occurs, then we have simply a transmission of blastogenic, by no means of somatogenic characters, and therein is not the slightest admission of the transmission of acquired characters.

LITERATURE CITED.

(1) **van Bemmelen,** De erfelijkheid van verworven eigenschappen. s'Gravenhage, 1890.

(2) **Bonnet,** Die stummelschwänzigen Hunde im Hinblick auf die Vererbung erworbener Eigenschaften. Beitr. z. pathol. Anat., Bd. IV.

(3) **Ritzema Bos,** Zur Frage der Vererbung von Traumatismen. Biolog. Centralbl., XI. Bd., Nr. 23, 1892; ibidemein Zusatz zu voriger Arbeit von J. Rosenthal.

(4) **Brock,** Einige ältere Autoren über die Vererbung erworbener Eigenschaften. Biol. Centralblatt, VIII, p. 491.

(5) **Claus,** Ueber die Wertschätzung der natürlichen Zuchtwahl als Erklärungsprinzip. Wien, 1888.

(6) **Detmer,** Zum Problem der Vererbung. Archiv f. die ges. Physiologie, XL, 1887.

(7) **Dingfelder,** Beitrag zur Vererbung erworbener Eigenschaften. Biol. Centralblatt, VII, p. 427, and VIII, p. 210.

(8) **Doderlein,** Schwanzlose Katzen. Zool. Anzeiger, X, and Biol. Centralblatt VII, p. 721.

(9) **Eimer,** Die Entstehung der Arten auf Grund von Vererben erworbener Eigenschaften, I. Teil. Jena, 1888.

(10) **Geddes and Thomson,** The Evolution of Sex. London, 1889.

(11) **Haacke,** Das Endergebniss aus Weismann's Schrift: Ueber die Zahl der Richtungskörper und über ihre Bedeutung für die Vererbung. Biol. Censralblatt, VIII, p. 282, and 330.

(12) **Hatschek,** Bedeutung der geschlechtlichen Fortpflanzung. Biolog. Centralblatt, VII; also in Prager med. Wochenschrift, 1887.

(13) **Hensen,** Die Grundlagen der Vererbung. Zeitschrift f. wiss. Landwirtschaft. Berlin, 1885.

(14) **Hertwig, O.** Vergleich der Ei- und Samenbildung bei Nematoden. Eine Grundlage für celluläre Streitfragen. Arch. f. mikr. Anat. Bd. 36, 1890.

(15) **Hoffmann,** Kulturversuche über Variationen im Pflanzenreiche. Botan. Zeitung, 1887.

(16) **von Kolliker,** Das Karyoplasma und die Vererbung. Zeitschrift f. wiss. Zoologie, 1886; also Eröffnungsrede der ersten Versammlung der anat. Gesellsch. in Leipzig. Anat. Anzeiger, III, 1888.

(17) **Kollmann,** Vererbung erworbener Eigenschaften. Biolog. Centralbl., VII; Handskelett und Hyperdactylie. Anat. Anzieger, III, 1888.

(18) **von Nageli,** Mechanisch-physiologische Theorie der Abstammungslehre. München, 1884.

(19) **Nussbaum, M.,** Ueber die Veranderungen der Geschlectsprodukte bis zur Eifurchung, ein Beitrag zur Lehre von der Vererbung. Archiv. f. mikr. Anatomie, Bd. 23.

(20) **Orth,** Ueber die Entstehung und Vererbung individueller Eigenschaften. Leipzig, 1887.

(21) **Richter,** Zur Theorie der Kontinuität des Keimplasmas. Biol. Centralblatt, VII; Zur Vererbung erworbener Eigenschaften, ib. VIII; Ueber die experimentelle Darstellung der Spina bifida. Anat. Anz.. III.

(22) **Roth,** Thatsachen der Vererbung, 1885.

(23) **Roux,** Der Kampf der Teile im Organismus, Leipzig, 1881; Beiträge zur Entwicklungsmechanik des Embryo. Virchow's Archiv., Bd. II.

(24) **Schiess,** Uebertragung erworbener Eigenschaften. Biol. Centralbl., VIII.

(25) **Schiller-Tietz,** Inzucht und Konsanguinität. Osterwieck, 1887; Vererbung erworbener Eigenschaften. Biol. Centralbl, VIII.

(26) **Strasburger,** Neue Untersuchungen über den Befruchtungsvorgang bei den Phanerogamen als Grundlage für eine Theorie der Zeugung. Jena, 1884.

(27) **Vines,** Lectures on the Physiology of Plants. Cambridge, 1886.

(28) **Virchow,** Ueber Transformismus. Biol. Centralbl., VII; Ueber künstliche Verunstaltungen des menschlichen Korpers. Vortrag geh. auf d. Naturf. Köln, 1888.

(29) **de Vries,** Intracelluläre Pangenesis. Jena, 1889.

(30) **Waldeyer,** Ueber Karyokinese und ihre Bedeutung für die Vererbung. Deutche mediz. Wochenschrift, 1889.

(31) **Weigert,** Neuere Vererbungstheorien. Schmidt's Jahrb., 1889.

(32) **Weismann,** Ueber die Dauer des Lebens, 1881; Ueber Vererbung, 1883; Ueber Leben und Tod, 1883; Die Kontinuität des Keimplasmas als Grundlage einer Theorie der Vererbung, 1885; Die Bedeutung der sexuellen Fortpflanzung fur die Selektions-Theorie, 1886; Ueber die Zahl der Richtungskörper und über ihre Bedeutung fur die Vererbung, 1887; Ueber die "vermeintlichen" botanischen Beweise für eine Vererbung erworbener Eigenschaften, 1888; Ueber die Hypothese einer Verebung von Verletzungen, 1888. (These eight papers have been translated into English and published together as "Essays upon Heredity and Kindred Biological Problems," 1889, Oxford, Clarendon Press.) Amphimixis oder die Vermischung der Individuen, 1891. (This, with three other essays, forms Vol. II of the English translation, cited above; it appeared in 1892.—*Translator.*)

(33) **Wiedershiem,** Der Bau des Menschen als Zeugnis für seine Vergangenheit. Freiburg, 1887.

(34) **Zacharias,** Ueber schwanzlose Katzen. Biol. Centralbl., VIII; Zur Frage der Vererbung von Traumatismen, ibidem, VIII; Das Forterben von Schwanzvertstümmelungen bei Katzen, ibidem, VIII.

(35) **E. Ziegler,** Können erworbene pathologische Eigenschaften ererbt werden und wie entstehen erbliche Krankeiten und Missbildungen? Beitr. zur pathol. Anatomie, I Bd.; Die neuesten Arbeiten über Vererbung und Abstammungslehre und ihre Bedeutung fur die Pathologie, ibidem Bd. IV; Ueber Tuberkulose und Schwindsucht. Sammlung klin. Vortrage, No. 151, 1878.

CERTAIN SHELL HEAPS OF THE ST. JOHN'S RIVER, FLORIDA, HITHERTO UNEXPLORED.

By Clarence Bloomfield Moore.

Fifth Paper.

General Conclusions.

STONE IN THE SHELL HEAPS.

It will be remembered that the district drained by the St. John's River is destitute of stone; the "rock" of the Indian River, which stream is closely approached by the St. John's near the headwaters of the latter, being a conglomerate entirely unsuitable for the manufacture of piercing or cutting implements.

It will be remembered also that in the shell-heaps of the river, even those giving evidence of greatest antiquity through absence of pottery, through infrequent occurrence of anything denoting the agency of man, and through other indications, implements of stone, though infrequent, have been found at all depths. Professor Wyman was present at the finding at the base of the shell-heap at Horse Landing, (Putman Co.,) of a piece of flint rudely worked, which he pronounced contemporary with the earliest stage of the mound. The writer realizing the importance of this discovery in a shell-heap in which, so far as Professor Wyman's and his own investigations have resulted, no pottery exists, twice visited Horse Landing and made a careful examination of the bluff. The flint in question was found in a section of a shell-heap laid bare by the action of the river, and the writer entertained the idea that the implement was possibly from the talus at the foot of the bluff, in which event the value of the find would have been materially lessened, if not entirely nullified. Fortunately, of all the shell-heaps of the river the composition of that at Horse Landing, most readily lends itself to an accurate estimate of the authenticity of objects found. Unlike the majority of the river shell-heaps, that at Horse Landing does

not rise from the level of the water, but is piled upon a bank of sand a number of feet above the river. All debris from the section laid bare falls a distance below the shell deposit, and an implement found embedded at a point in the sand where the shell begins is considerably above the debris from the section, and must, in the writer's opinion, have occupied that position since the foundation of the shell-heap.

During the investigations of the writer, which covered a period of upward of seven months during the years 1892--1893, steam motive power reducing to a minimum time devoted to transit, several hundred excavations were made in upward of eighty localities. But a small number of objects of stone were discovered under conditions positively identifying them as being contemporary with the construction of the heaps; a number entirely disproportionate, one would think, to the amount of material displaced.

Before proceeding to a detailed account of the worked stone found by the writer in the shell-heaps of the St. John's, it may be well to specify the nature of the conditions referred to above. The writer has had occasion to state in previous papers of this series that the shell-heaps were occupied as a place of residence by later Indians, and that some at least were cultivated by them. The maximum depth of a furrow in a shell-heap is eight inches, and it is probable that the rude implements of the Indians went no deeper. Allowing ten inches as a maximum deposit of surface loam since the final abandonment of the mound, a depth of eighteen inches is arrived at, lower than which it is necessary to go to insure a satisfactory identification as to the period to which any implement belongs.

If, however, sweet oranges are growing upon the shell-heap it is necessary that even a greater depth be attained. It is believed that the sour orange trees, so numerous upon many of the shell-heaps, are descended from sweet trees run wild, planted by later Indians from seed furnished by the Spaniards. Be this as it may a majority of the shell-heaps north of Lake Harney were until a comparatively recent date thickly covered with a growth of sour orange trees. It has been found in Florida that the most available orange trees are derived from

sweet budding upon sour orange stock. After this is accomplished it becomes necessary to place the trees in line and to remove many that no tree may be deprived of sunlight. For the removal of trees and for the " lining " of others, pits three feet in depth are necessary. It is well, therefore, to bear in mind that implements unquestionably of the shell-heaps must be found at a depth greater than three feet in sweet orange groves, and over eighteen inches from the surface in shell deposits not utilized for the cultivation of the orange. The writer, while handling the spade in an orange grove at St. Francis, found at a depth of three feet a thin and beautifully proportioned arrow head, evidently of the time of the later Indians, and conversely he has seen upon the surface in orange groves, arrow points unquestionably of the time of the shell-heaps.

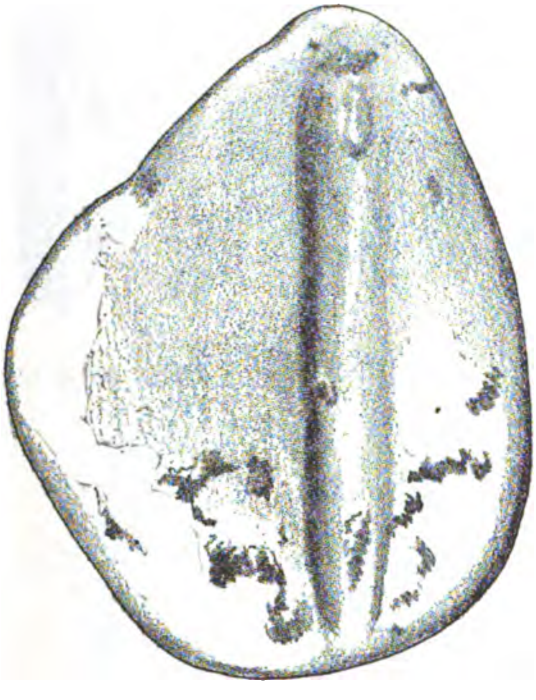


Figure 1.—Grooved Sandstone Hone. (Actual size).

Stone implements known as "sinkers" have never been met with by the writer other than superficially, though hones of sandstone with grooves worn by the friction of pointed tools were contemporary with the later heaps at least. Fig. 1 is from Turtle Mound,[1] Brevard Co.

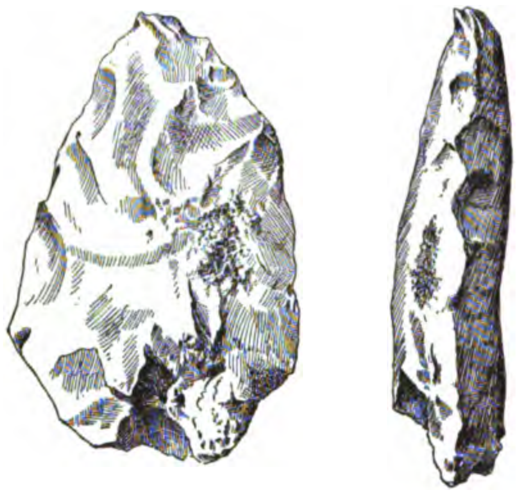


Figure 2.—Arrow Head, Morrison's Creek. (Actual size).

Figure 3.—Arrow Head, Mt. Taylor. (Actual size).

No grooved axes are known to have been found on the river under any circumstances.

---

[1] Not the great marine shell-heap near New Smyrna.

During the entire investigation of the writer but one implement in any way resembling a chisel or hatchet was brought to light, that could positively be ascribed to the period of the shell-heaps. This was an implement of polished greenstone figured and described in the AMERICAN NATURALIST, August,

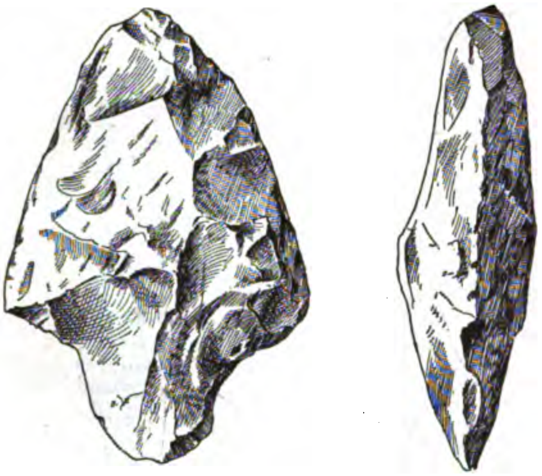


Figure 4.—Arrow Head, Ginn's Grove. (Actual size).

Figure 5.—Arrow Head, St. Francis. (Actual size).

1893. This object, the only one of polished stone known to belong to the epoch of the shell-heaps of the St. John's, was found at a depth of 4½ feet from the surface in Mulberry Mound, Orange County, which is believed to be one of the very latest shell-heaps of the river.

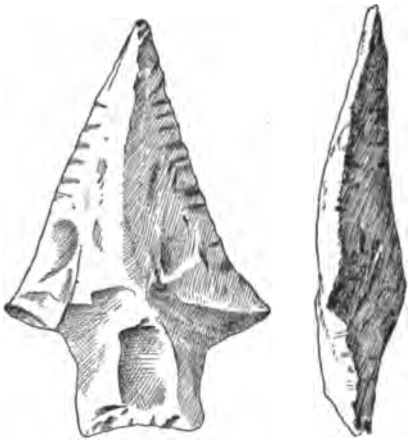


Figure 6.—Arrow Head, shell-heap near Puzzle Lake. (Actual size).

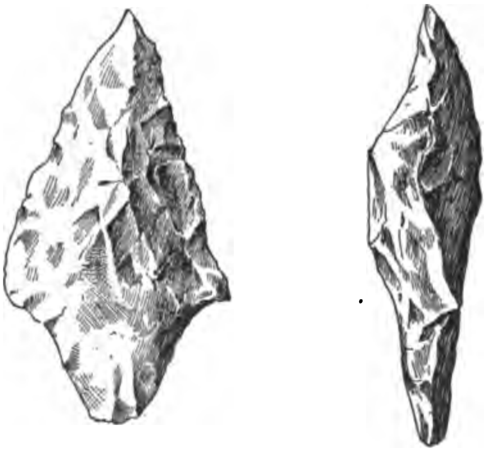


Figure 7.—Arrow Head, Bryson's Mound. (Actual size).

ARROW AND SPEAR POINTS CONTEMPORARY WITH THE SHELL HEAPS.

FOUND IN PLACE BY THE WRITER.

1.—Two arrow heads of chert from the swamp shell-heap near Morrison's Creek, (Volusia Co.,) lying on fire-place four feet eight inches from the surface.[3] Of these, one is figured (Fig. 2). Though carried to a depth of nine and one half feet, this excavation showed no pottery below two feet from the surface.

2.—Two arrow heads of chert and one of chalcedony from the great swamp shell-heap near Volusia, known as Mt. Taylor, (Volusia Co.,) respectively four and one-half (Fig. 3), six and one half and eight feet from the surface. All three lay upon fire-places. A careful search in many parts of this shell-heap showed no pottery whatever.

3.—One arrow head of chert at Ginn's Grove, (Orange Co.,) five miles south of Sanford, at a depth of two feet (Fig. 4). No orange trees grow on this deposit. No pottery found in it, though comparatively abundant in an adjacent shell field.

4.—One arrow head of chalcedony at a depth of six feet on a fire-place in the crescentic shell-heap at St. Francis, (Old Town), (Lake Co.,) (Fig. 5). Many excavations showed no pottery below four and one half feet from the surface.

5.—One arrow head of chert six and one half feet from surface on fire-place in shell-heap west side of Puzzle Lake, (Orange Co.,) (Fig 6). No pottery found below a depth of two feet.

6.—A fragment of spear head of chalcedony at Orange Mound, (Orange Co.,) about twenty-one miles by water

---

[3] It will be seen that a majority of the arrow heads were found immediately upon fire-places, and of the remainder, the writer is unable to state that such was not also the case. With some were the bones of lower animals. It has been suggested to the writer that as it is unlikely that weapons so comparatively scarce as were arrow points at the period of the shell-heaps, should be lost without some reason, the stone points met with by him were thrown on the fire-places buried in the carcasses of animals. This seems a not unlikely hypothesis.

south of Lake Harney. Deep and numerous excavations gave no pottery below seven and one half feet.

7.—One arrow head of chalcedony in Bryson's Mound, (Volusia Co.,) (Fig. 7). This arrow head was not found when thrown out, but as it lay among material belonging to a stratum not seen within three feet of the surface, its depth may be set down at from three to five and one half feet. Sour orange trees only.

8.—One spear head of bluish chert in the shell-heap on Salt Run, Lake George, (Marion Co.,) at the bottom of the heap three and one half feet from the surface. No pottery found anywhere in this shell-heap below surface loam. No orange trees.

9.—One arrow or spear head of hornstone beveled on both sides 2.34 inches long with maximum thickness of .47 inch, four feet from surface in conical shell-heap in swamp one mile north of Astor, (Lake Co.,) near fire-place. No pottery discovered in this mound beneath surface loam.

10.—Three lance heads about fourteen feet from surface in Mulberry Mound, (Orange Co.). Two of fine chert, thin and of graceful pattern; one of somewhat ruder workmanship fashioned from coarse, yellow chert. These lance points have been described in a previous paper and many reasons adduced why Mulberry Mound must be considered among the very latest of the shell-heaps. Ornamented pottery was found to water level.

As will be seen by the figures, the arrow heads of the presumably earlier shell-heaps are rude in type. They are also characterized by unusual thickness.

Stone implements of the St. John's River are distinctly neolithic, though Professor Wyman in error characterized certain rough specimens found by him as of the St. Acheul type.[3]

The writer has submitted to Professor Haynes a representative collection of rude chipped implements of various sizes, presented to him and reported as coming from the shell-heaps by owners of orange groves and other responsible persons.

---

[3] Fresh Water Shell Mounds of the St. John's River, Florida, page 49,

These implements Professor Haynes carefully studied, and writes af them as follows:

"No one of them, in my judgment, resembles the genuine paleolithic implements of western Europe, and I am no believer in any paleolithic period in North America different from that of the old world. By this I mean a time when man was living in some regions as the contemporary of animals, now extinct or migrated to colder countries, like the mammoth and reindeer, and had for his principal tool a type of stone implement peculiar in its shape and method of fabrication and of use. Such implements also show upon their surface characteristic indications of their great antiquity. I think genuine paleolithic implements, so understood, have been discovered in the United States, but yours do not fall within that category, in my opinion, although they somewhat resemble them in shape. But so also do many objects found all over our country which must, nevertheless, be classed as rude, or unfinished Indian implements, although they have been supposed to be like genuine paleolithic implements, by some persons not sufficiently informed upon the subject."

FOOD SUPPLY.

While dredging for specimens of modern shells in the lakes, creeks and lagoons in the neighborhood of the St. John's River, the writer had ample proof that the supply of paludinæ is greater at the present time than has previously been reported. Whole lake bottoms are covered with them, while they are found in abundance in numerous creeks and lagoons. The writer knows by experience that the ampullaria and the paludina make a nourishing and not unpalatable soup. Still it is probable that the aborigines varied their diet to as great an extent as possible. Bones of the dog, the red lynx and a member of the sheepshead family of fish, hitherto unreported as articles of diet, were discovered in shell-heaps by the writer.

It is difficult to arrive at a conclusion in respect to the bison, known to have inhabited Florida within a period of which there is historical record. No bones belonging to this animal were found by Professor Wyman, nor has the

writer succeeded in discovering any. A molar, identified by Professor Cope as belonging to a bison, was presented to the writer by Mr. C. H. Curtis of Bluffton, Volusia Co., who stated that it had been superficially found on the shell deposit at that place. It is possible that future investigation will show the bones of the bison to be present in the shell-heaps of the St. John's. Their presence in those of Georgia has been noted.[4]

While the remains of various fish are found in the shell deposits they are by no means so numerous as might be supposed considering their great abundance in the river. The absence at any considerable depth of "sinkers" of stone, believed to have been used for cast-nets, as has been stated, seems to indicate their use as confined to the close of the shell-heap period. Nothing in any way suggesting a fish hook has ever been found in the river heaps. It is probable that the main supply of fish was obtained through the medium of the spear, a method known to have been practiced by later Indians.[5]

AGE OF THE SHELL HEAPS.

There seems to be no reason to doubt that a wide divergence in time characterizes the construction of the shell-heaps of the river, and that many were completed before others were begun. Mt. Taylor, Volusia Co., has a maximum height of over 27 feet. Many and considerable excavations made in every part with an adequate force of men have failed to reveal a fragment of pottery beneath the surface loam. The removal of the entire heap (a work of months) could alone afford absolute proof, but the result of repeated excavations is a strong indication of absence of pottery in the mound.

Mulberry Mound near Lake Poinsett, an island shell-heap rising 16 feet above the water level, is composed of crushed shell and sandy loam, showing slow growth beneath the tread of its inhabitants. Ornamented sherds were met with to the very bottom. Colored pottery was found, and an article of personal adornment, while on a preceeding page has been

[4] C. C. Jones "Antiquities of the Southern Indian," page 200.

[5] The writer has found iron fish spears near the surface of the sand mounds.

related how graceful weapons lay near the base—weapons entirely at variance with the pattern of those of presumably older mounds. The men who dropped the first unios on the low marsh where Mulberry Mound now stands, probably came long after the aborigines abandoned Mt. Taylor. One can readily realize, then, that the shell-heaps are by no means contemporary, and that the beginning of the earliest must date from a period comparatively remote, not, so far as any proofs exist, from a time approaching that of the great mammals, but one far antedating the coming of the whites.

Since the appearance of the first paper of this series, the writer has (1893) carefully gone over many shell-heaps included in his first paper, and has added to the list a considerable number from seven localities. With a force of eight men to handle the spades, the writer has in addition carefully examined nearly all the shell-heaps described by Wyman, and in none has he found any indication of intercourse with Europeans, in this result coinciding with the researches of Professor Wyman.

Numerous objects found by those having shell-heaps under cultivation have been described to or inspected by the writer, but in no case has there been any evidence of the discovery of anything suggesting other than the product of unaided aboriginal industry.

History is singularly rich in accounts of the manners and customs of the natives of Florida, beginning at a period not long subsequent to the landing of Columbus. In all these accounts, written with scrupulous regard for detail, there is nothing to indicate the existence of native races so low in the scale of humanity as must have been those who piled up the greater portion of the shell-heaps. We are told by the Knight of Elvas[6] of the superior quality of the pottery of the Southern Indians. We look in vain in the shell-heaps for evidence upon which such an assertion could have been based. In the face of such a mass of negative evidence, unless proof to the contrary be adduced, the shell-heaps must be considered as abandoned in pre-Columbian times.

A point brought forward in the initial paper of this series

[6] Cited by C. C. Jones "Antiquities of the Southern Indians," page 445.

for the sake of emphasis will be repeated here. In certain shell-heaps at various depths from the surface fragments of pottery, which have gradually been decreasing in number, entirely disappear, indicating, in the writer's opinion, the inception of the manufacture of pottery during the progress of the erection of the heap. The absence of pottery cannot be accounted for under the hypothesis of decay, since no stratum containing partially decayed sherds is met with in any of the river shell-heaps. If the occurrence of shell-heaps devoid of pottery is admitted on the St. John's, and as to this a careful investigation can leave no doubt, it would be difficult to assign a reason for the absence of this necessity of aboriginal life, save ignorance of the method of its manufacture,[7] and assuming this to be the case, there would seem to be no cause why certain shell-heaps should not show by internal evidence the inception of the art.

In conclusion, the writer would state as his opinion, that while the shell-heaps of the St. John's have been imperfectly explored, and while many interesting questions still remain unanswered, but little work will be done in connection with them in the near future. The territory to be covered is so vast, and the shell-heaps of the upper river are so inaccessible that one may well hesitate before undertaking an exploration involving so much trouble and expense. Moreover, but little is found in comparison with the vast quantities of debris to be handled, and the relics of the wretched makers of the shell-heaps offer but a poor incentive in comparison to the more alluring results to be attained in other portions of the country.

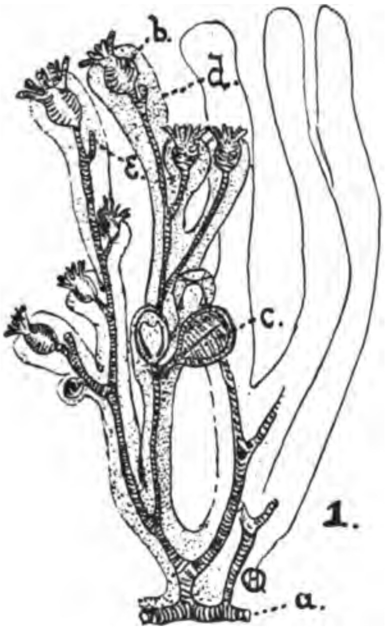
[7] It has been asserted that the absence of pottery in certain shell-heaps is explainable under the hypothesis that the people frequenting the shell-heaps dwelt there for but a portion of each year and made the earthenware vessels elsewhere. This seems untenable. It matters little where the pottery was made. If possessed by the occupants of the shell-heaps it certainly would be *used* there, for numerous fire-places and broken bones at all depths testify to culinary pursuits. Earthenware is too brittle to allow one for an instant to suppose that numerous vessels would not be broken as they were on so many shell-heaps. Moreover it is difficult to comprehend why some shell-heaps should be marked by the manufacture of earthenware, while others give no evidence of its production. Rude masses of baked clay and in one case a vessel filled with clay unbaked were found by the writer in shell-heaps.

The conclusion seems difficult to escape that where earthenware is not found, its manufacture was unknown.

PERIGONIMUS JONESII; A HYDROID SUPPOSED TO BE NEW, FROM COLD SPRING HARBOR LONG ISLAND.

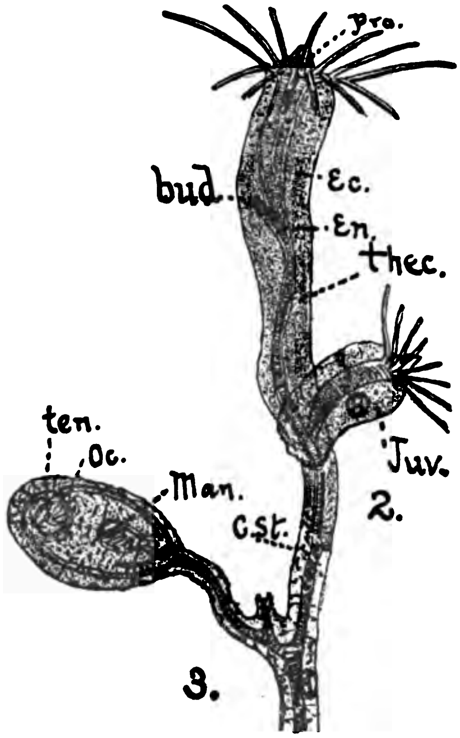
BY HENRY LESLIE OSBORN AND CHARLES W. HARGITT.

The authors of this article, while engaged in seaside studies at Cold Spring Harbor, at the Laboratory of The Brooklyn Institute, found a certain hydroid which is the subject of this article. A careful survey of the accessible literature of the subject has failed to demonstrate that it has been previously described, though its very common occurrence together with the ease of its capture render it remarkable that it should have escaped the hands of the collector heretofore. It is a very interesting species on account of the very primitive state of development of the integument, if we may so call the theca or skeleton, and hence of interest to the biologist, for whose sake,



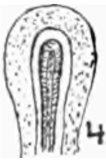
rather than merely for the sake of its faunal interest, these notes are written.

The species occurs very commonly as a flesh-tinted scum on the abdomen or on the tips of the joints of the walking legs (pereiopods) of the Channel Crab *Libinia emarginata.* This crab lives abundantly a very lazy life in the deeper waters near the mouth of Oyster Bay and in the bays and sounds generally that connect with the Atlantic Ocean in the latitude of Long Island. If specimens of the crab be placed immediately upon capture in an aquarium, the hydroid, if present, can be seen as a fleshy fuzzy mass in the midst of the rather abundant hairy material that covers the creature on the ventral surface quite generally. The hydroid is thus a messmate of the crab, but there is no proof that I know of that the latter is in any way affected by the presence of this lowly companion. There is a disease of a certain fish caused by the presence of a parasitic hydroid described by Fewkes as *Hydrichthys mirus*



[Bull. Mus. Comp. Zool., Vol. XIII, p. 224]. In this case however, it was not certain that the parasite did any damage to the fish. It is not impossible that a hydroid could get into such a relation to the soft tissues of a crab at the joints as to be a harmful resident there, but we know of no proof that such is true of *Perigonimus jonesii.*

An examination of the colony with the low power shows that it is a very much branched mass of stalks arising from stolons that ramify on the surfaces offered by the shelly outer covering of the host. The colony is, unlike most of the other species of this genus, very closely and luxuriantly branched, and the two kinds of persons are both carried on the same stalk. The stalks are terminated with one oldest zooid and below it are the younger ones and the gonozooids. The hydriform persons or hydrozoids are, as shown in figure 2, only slightly differentiated into a body separate from the stem and in this respect it is of the more primitive hydroid form. The tentacles are not numerically constant but are about sixteen in number. They tend, when fully expanded, to assume an alternately reflexed position. They are confined to a single row at the base of the proboscis. This is also a primitive character. The stem just at the base of the body proper of the hydrozooid bears a little bud not sufficiently developed to project beyond the outline of the cuticle. The interesting thing about this hydroid to the biologist is the very primitive condition of the external skeleton. This is a gelatinous investment that covers the stem and the body in every part. It is so soft and flexible that it follows all the movements of the body and stem without any apparent resistance. This cuticle reaches upon the body to the level of the tentacles to which it is fastened, as is shown by the fact that it is moved about with them as the animal waves them to and fro, and it is retracted with them as the proboscis is drawn


4.

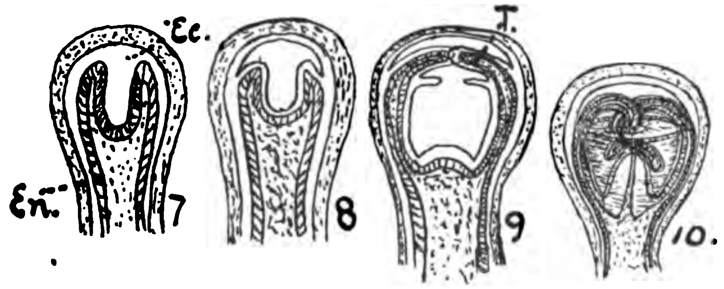

5


6.

down to the slight extent that is possible to the animal. The covering is of the most delicate texture but strong enough to hold firmly together in all the movements of its possessor. In the older parts the cuticle is somewhat more opaque and is more or less stuck up with dirt and such things.

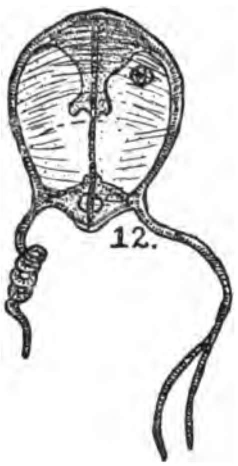
The gonozoids are budded in clusters from the sides of the stem near its centre, they have an investment of cuticle which entirely covers them, and the bell develops to its time of release but not to its maturity in this case, and can then be seen to break off from the parent stock and swim away for itself. The stages in the development of the bell are as usual in this order. They are as follows. It appears as a minute bud on one side of the stalk, and not for some time can it be seen whether it is to give rise to a medusa or to a polyp. An enlargement into a somewhat spherical head usually indicates the medusoid character of the bud. This process is quite gradual as may be seen from the figs. 4, 5 and 6, all of which, while somewhat diagrammatic, were sketched directly from living or preserved and mounted specimens. As has been said, they follow the general course of development common to the order. *Cf.* Lang, Comp. Anat., p. 105, *et seq.*

The first differential change that occurs is a thickening of the peripheral ectoderm at the extremity of the bud, with an accompanying invagination extending to the entoderm; fig. 4. This continues as shown in figs. 7 and 8. In this process there occurs what may be designated as a cleavage of the ectoderm of the outer margin of the bud, and which extends for some distance around the bell, fig. 8. The outer portion constitutes the outer ectodermal envelopes of the medusa, and is ruptured and finally atrophies at, or immediately before, the



final separation of the medusa. The inner layer of the ectoderm continues to invaginate, making the ectodermal lining of the bell, and giving rise to the tentacles and velum. *Cf.* figs. 9 and 10.

From a glance at figs. 11 and 12, it will be seen that the tentacles are relatively very long, but in mature specimens they are much longer than represented. Their disposition during the period of development is quite interesting. It is measurably indicated in fig. 9. They are from the first turned inward and soon enter the interior of the bell, being nicely folded and filling the entire cavity. This habit is not abandoned immediately on the separation of the medusa. In many cases under observation the medusa, when suddenly disturbed, would at once contract the tentacles, and, seeking the mouth of the bell, dispose them within, and at the same time assume an almost spherical form and thus remain for some time or till the disturbance ceased.



The development of the radial and circumferential gastric canals proceeded, *pari passu,* with the growth of the medusa. This was very easily demonstrated by the active circulation which was observed extending to the very tips of the tentacles and over the middle of the bell to unite with the circumferential canal at the optic spots. No special histological investiga-

tions were made, but it seemed highly probable that the canals arose after the manner described by Lang, (*op. cit.* p. 73.)

The development of the manubrium calls for no special account. Its origin is illustrated in fig. 9, it is also shown in fig. 3.

The origin of the mouth is simply through the rupturing of the terminal walls of the manubrium, and was observed in several cases, and seems to be after the method common throughout the order so far as known.

There is not the least difficulty in obtaining the young medusa or in keeping them alive in aquaria for a considerable period of time. We had them as long as fifteen days and examined them constantly, but we did not succeed in rearing them to maturity. At the time of their liberation from the hydroid stock the reproductive organs had not yet made their appearance.[1] Perhaps a later study of this creature will disclose a way in which this important link in the life history can be discovered. Until this important fact, the definitive form of the medusa, is supplied, the generic affinity of the species must remain in uncertainty. There are indications enough, however, to justify its provisional assignment to the genus Perigonimus of Sars. Not only are the structure of the hydroid stage and the structure of the young medusa, in favor of this, but this species shares with nearly all of the remaining members of the genus the habit of commensalism. Thus *P. repens* is found on the shells of the hermit crab, *P. minutus* lives on the shells of Turritella, *P. vestitus* is attached to the shell of Buccinum, and *P. repens* is reported from the shells of Libinia in the British Islands. The form we are now considering, while it is generically related at least in the hydroid and early medusoid stage to the Genus Perigonimus, is not, so far as we have been able to learn, specifically related to any described species. We have, therefore proposed to give it the name *Perigonimus jonesii*, to commemorate the founder and constant friend of the Cold Spring Biological Laboratory, Dr. Jones. The great luxuriance

---

[1] In one instance, figured in No. 12, one of the tentacles was bifid. It was distinctly double from the point of its origin and was plainly a monstrous character rarely found. Each portion of the tentacle was moved independently but both tended to be retracted together on stimulation.

of the branching, together with the origin of the medusæ from the stalks bearing the hydroid members, and the presence of several medusæ originating at a common point of attachment to the parent stem are the specific characters that have required the erection of this new species.

For convenience the species of the genus are summarized here.

P. repens, tentacles all erect, about 18–20, medusæ and hydroids simple, arising separately from a creeping hydrorhiza, young medusa bi-tentaculate.

P. minutus, tentacles 7, medusæ arising from the simple or very sparingly branched hydroid persons, on shells of Turritella.

P. vestitus, tentacles 8, alternately reflexed, medusæ arising either from the hydrorhiza or from the hydroid person, not in clusters; hydroids not branched, young medusa bi-tentaculate, On shells of Buccinum.

P. palliatus, tentacles, 8 alternately reflexed, thick gelatinous coat as far as the bases of the tentacles, gonophores arising from the hydrorhiza. On shells of the hermit crab.

P. jonesii, tentacles 16, alternately reflexed, thick gelatinous coat as far as the bases of the tentacles; medusæ and hydroids on the same stalks, hydroids luxuriantly branched and mudusæ clustered, young medusæ bi-tentaculate. On shells of Libinia.

To the morphologist a form like the one just described has peculiar interest because of the many primitive characters which are united in it. It is not improbable that the higher calyculate Campanularian Hydroids may have been descended from athecate ancestors that were more or less closely like the genus Perigonimus. This is a very lowly form of the tubularians, having only a single row of tentacles, the mode of reproduction is very simple, and the medusa is of a most simple character. Still while Perigonomus is treated among the naked hydroids, it has a covering. This covering is such a one as such an animal as the naked hydroids might have in their earlier stages of the acquisition of a strong skeleton. It is not a highly differentiated product, but a delicate, hardly compacted slime not very unlike the mucous secretions that all

animals are so commonly throwing off from their bodies. If the semi-fluid coat of this sort were stiffened only a little, we should arrive at the more compact chitinous cuticle of the calyculate forms. The case of Perigonimus thus furnishes a suggestion of the probable history of the chitinous cuticle of the hydroids; at first a thin envelope, later a stiffened cover forming a greater protection to the body and providing for freedom of motion by the development of joints at stated intervals. The facts of ontogeny are in favor of such a view of the history of the cuticle, for we know that the cuticle arises as an excretion thrown off from the ectoderm and hardened on exposure to the water. And the differences between the gelatinous and the chitinous cuticle, are such differences in the chemical or metabolic functions of cells as could conceivably easily come within the range of operation of natural selection. It is of great interest then to find so primitive an animal with so primitive a mode of skeleton building, and whether the creature is really a primitive one or its primitive characters are only secondarily acquired it is one the entire life history of which would be full of interest.

Explanation of the figures.

Fig. 1.—View of general mode of branching and situation of medusæ. *a* hydrorhiza; *b.* hydroid person; *c.* medusa bud; *d.* the gelatinous cov. *e.* a young hydroid bud.

Fig. 2.—Enlarged view of the terminal zooid showing the body, "ec," "en;" and the covering "thec;" the proboscis, "pro;" and a younger zooid, "juv."

Fig. 3.—View of a single one of the medusæ in position. *c. st,* the stem of the colony; *man.* the manubrium inside the bell; *oc,* the eye-spot at the location of a tentacle; *ten,* a tentacle.

Figs. 4, 5, 6, 7, 8, 9, 10, different successive stages in the growth of the medusa.

Fig. 11, a medusa just freed from the colony; *mn.* manubrium, *oc,* ocellus; *v.* velum.

Fig. 12, view of an exceptional specimen showing bifurcated tentacle.

Hamline, Minnesota, July 19th., 1893.

COURTSHIP AMONG THE FLIES.

J. M. Aldrich.[1]

The dipterous family Dolichopodidae perhaps surpasses all other families of animals in the variety and complexity of the sexual adornments of the males. These structures occur in some species in the tarsi, in others in the antennæ, face, wings, or other parts. Probably three-fourths of the species offer well-marked peculiarities which distinguish the male at a glance.

In the genus Dolichopus, the males are usually provided with tarsal ornaments, usually on the fore limbs. A new species, to which the following remarks apply, has the fore tarsi in the male exceedingly elongated and slender, with the last joint in the shape of a comparatively large, oval, black disk. In none of the numerous other species known to me is the attenuation of the first three joints so great. The tarsi of the female are of the ordinary simple structure.

This species is abundant about the edges of the streams, on the wet, bare earth, at Moscow, Idaho. I observed in September the maneüvers of the male in courting the female. He would place himself directly in front of her, at a distance of about half an inch, with his face toward her. He would then rapidly vibrate his wings, holding them horizontally, at right angles to the body, and at the same time would give these fore feet an up-and-down motion, raising them simultaneously above the level of the head and bringing them down with a slight force upon the ground, the movement recurring in a measured way in about half a second. This he would continue for some ten seconds; then, rising on the wing, he would swiftly make a small semicircle in the air and attempt to alight upon the female. In the large number of cases that I observed, he was always unsuccessful, the female hastily movaway a few inches, when the male would usually alight before her and repeat the movements just described. On account of the numbers that were engaged in this occupation on the same small area, I could not be certain that the same male always

---

[1] Moscow, Idaho.

attended upon a given female; but there can be no doubt that the females are exceedingly slow to accept the males, for I saw the above maneuver repeated hundreds of times with the same result.

In company with the species just mentioned occurred considerable numbers of a species of Hygroceleuthus, which I have referred to (Kans. Univ. Quarterly, II., 24) as a variety of *H. crenatus* O. S. These were engaged in a similar occupation. The male of this species has only plain tarsi, but differs from the female in having the antennal joints longer, the first two with coarse black hair, and the arista of the third short and heavily covered with black pubescence; the face is also longer, the wings broader, and the cilia of the tegulæ, instead of being coarse and chiefly black, are fine and white. The male hovers in the air before the female at a distance of one or two inches, occasionally making a slight darting motion towards her. In this position the peculiarities of his face and antennæ are shown to the best advantage. The breadth of the wings is probably of advantage only in facilitating this hovering process, and the structure of the tegular cilia may possibly be accounted for by supposing that it is simply in compensation for the increased growth of wings. This male, after hovering a few secends, describes a semi-circle in flight and attempts to alight upon the female as in the foregoing species, and with the same results. I observed the copulation only once, and then did not see the preliminaries.

I was much impressed by the perfect coincidence of these observations with Darwin's theory of sexual selection. The reluctance of the females, and the corresponding ardor and persistence of the males, is carried to an almost incredible limit.

In this connection the observations of Fr. Dahl (Zool. Anzeig., April, 1889) on another species of Dolichopus are of interest. I translate from a quotation in an article by Dr. W. M. Wheeler (Proc. Wis. Nat. Hist. Soc., April, 1889, p. 209), which mentions a somewhat similar habit in a gall-gnat *Asynapta antennariæ* Wheeler).

"The male species of fly, *Dolichopus plumipes* posseses on first tarsal joint of the middle legs a beautiful, regular fringe,

the purpose of which is not immediately perceptible, as the flattened hairs could not possibly serve to grasp the female. I have now observed the pairing of these insects, and am convinced that the structure serves as an actual ornament to the male, like the highly developed tail-feathers, etc., of a male bird. The male came flying up, and hovered for a time so close over the quietly-resting female that the fringed tarsi hung down immediately before her eyes. After some time copulation was attempted, but the female at once showed unwillingness. Only after repeated attempts did he succeed in gaining her acceptance."

EDITORIALS.

—THE edict of the Czar whereby the town of Dorpat is hereafter to be known as Juriew, and its university, where heretofore the lectures have been in either German or Russian, is to be thoroughly Russian now, suggests a question which is rapidly becoming a serious one to the scientific world outside of Russia. This is, what shall be done with the numerous papers published in the Slavic tongues? It is a serious task for the student to acquire a reading familiarity with the various Teutonic and Latin languages. Russian, Czech, and Polish, are almost impossible. And yet the tendency on the part of the Russian Government is to compel the exclusive use of that tongue. It is hereafter to be the language of all publications coming from the University of Juriew. Must the student of science hereafter add a knowledge of Russian to his other linguistic attainments? or is he justified in neglecting all Sclavic productions, just as he would those in Japanese, until they are translated into one of the languages previously in scientific use? Cannot our various International congresses discuss the question as to what languages shall be recognized as the proper vehicles for the publication of the results of research, and come to some agreement whereby all papers printed exclusively in languages outside those of the Teutonic and Roman stocks are to be regarded as not published. Protests by the Western World are of no avail with the Czar, but the fact that the difficulty is such as to produce a practical boycott may produce good results.

Since writing the above a case to the point has arisen. In the last number of the "Morphologisches Jarbuch" the brilliant embryologist, Goronowitsch, takes Miss Julia B. Platt to task for ignoring previous literature. The facts are these. Miss Platt announced that the cartilages of the vertebrate head are ectodermal in origin, and in support of her views she quoted from the available literature, including one paper by Goronowitsch. Mr. Goronowitsch complains that she neglected two other papers by himself, one of which was in Russian.

—THE city council of Philadelphia made an appropriation for the purpose of securing certain collections of objects of Natural History which were exhibited at the Exposition at Chicago. The matter was placed in the hands of Professor W. P. Wilson of the University of Pennsylvania, who carried out the object of his mission successfully, as he has

obtained a large amount of valuable material. It is now proposed to erect a building for the purpose of accomodating the collection. To this proposition it may be objected that we have already in Philadelphia a sufficient number of buildings adapted to museum purposes, so that to erect a new building is to divert money from a more important object, viz., that of securing the care of the specimens, and their use as means of scientific research. The expenditure of money for museum buildings has secured enough space and shelter for the materials of research and for the investigators for a long time to come, so that the endowment of scientific research should now claim attention. An appropriation for this purpose would be of more utility than any other that can now be made, for it has been a necessity in the community for a long time. Scientific results can not be expected without provision for investigators, and this is lacking in almost all our institutions.

—Two prizes have been offered by a member of the Anthropological Society of Washington for first and second essays which shall contain a definition of the "Most useful citizen of the United States regardless of occupation." In our next number we will give the details of the plan in full. Such a definition may be summed up in a few words, or it may cover the fields of social and political science. We shall look with much interest to the responses which this offer shall bring out. Men's ideas of the highest utility are various, and, they differ as well in regard to utility in detail. Many persons possess a bias in favor of their own pursuits, which is natural. So far as this project encourages thought, and stimulates serious endeavor, it will be itself of no small utility.

—WE must again request our **correspondents** and **exchanges** to send M.S. and printed matter of all kinds, except proofs, to the office of the editor 2102 Pine Street, Philadelphia. We except of course such as are designed for the use of our Editors of departments. This course expedites their reception and acknowledgement at all times; and when we change publishers as we occasionally do, such matter is apt to be lost.

RECENT BOOKS AND PAMPHLETS.

Allen, H.—On the Foramen Magnum of the Common Porpoise, and on a Human Lower Jaw of Unusual Size.——The Forms of Edentulous Jaws in the Human Subject. Extrs. Proceeds. Phila. Acad. Nat. Sci. 1893. From the author.

Arthur, J. C.—A New Factor in the Improvement of Crops. Extr. Agri. Sci., Vol. VII, 1893. From the author.

Benedict, J. E. Notice of the Crustaceans collected by the U. S. Scien. Exp. to West Africa. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Inst.

Cannon, G. L.—The Tertiary Dinosauria. Extr. Mining Industry, Vol. III. From the author.

Chenoweth, C. **Van** D.—Address to Psychological Section of Medico-Legal Society. New York, 1893. From the Soc.

Clark, W. B.—Bulletin No. 97 of the United States Geological Survey.——The Mesozoic Echinodermata of the United States. Washington, 1893. From the author.

Contributions from the Botanical Laboratory of the Penna. Univ., Vol. 1, No. 2, 1893.

Dixon, S. G.—Address on Hygiene. Read before the Meeting of the Pa. State Med. Soc. 1893. From the author.

Fairchild, H. L.—Proceedings of the Fifth Annual Meeting, held at Ottawa, Canada, Dec. 28, 29 and 30, 1892. Extr. Bull. Geol. Soc. Am. 1893. From the Society.

Fontaine, W. M. Notes on some Fossil Plants from the Trinity Division of the Comanche Series of Texas. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Inst.

Forsyth, C. J.—On some Miocene Squirrels, with Remarks on the Dentition and Classification of the Sciurinae. Extr. Proceeds. Zool. Soc. London, Vol. VIII, 1893. From the author.

Gegenbaur, G. Die Metamerie des Kopfes und die Wirbeltheorie des Kopfskelets, im Lichte der neureren Untersuchungen betrachtet und gepruft. Extr. Morpholog. Jahrb. 13. From the author.

Gibson, A. M. Report on the Geological Structure of Murphree's Valley and its Minerals and other Materials of Economic Value. Extr. Rept. Geol. Surv. Alabama, Montgomery, 1893. From E. A. Smith.

Gill, C. A.—Beiträge zur Kenntniss des Quarzes.——Inaugural. Dissertation der hohen philosophischen Facultat der K. G. S. Bayerischen Ludwig Maximilians Universitat zu München behufs erlangung der Doctorwürde. Leipzig, 1893. From the author.

Griswold, L. S.—A Basic Dike in the Connecticut Triassic. Bull. Harv. Mus. Comp. Zool., 1893. From Alexander Agassiz.

Hill, R. T.—The Invertebrate Fossils of the Caprina Limestone Beds. Extr. Proceeds. Biol. Soc. Washington, Vol. VIII, 1893. From the author.

Hoffman, G. C.—Catalogue of Section one of the Museum of the Geol. Surv. embracing the Systematic Collection of Minerals, etc. Ottawa, 1893. From the Can. Geol. Surv.

Hutton, F. W.—New Species of Moas.——On *Anomalopteryx antiqua.* Extrs. Proceeds. New Zeal. Inst., 1892.——On the Origin of the Struthious Birds of Australia. Extr. Proceeds. Aust. Ars. Adv. Sci. 1892. From the author.

Jordan, E. O.—The habits and Development of the Newt. Extr. Journ. Morph. Vol. VIII, 1893. From the author.

Leche, W.—Nachträge zur Studien über die Entwicklung des Zahnsystems bei den Säugethieren. Separat. Abdruck aus Morph. Jahrb. XX Bd. 2 Hept. Leipzig 1893. From the author.

Ludwig, H. von.—Vorlaufiger Bericht über die erbenteten Holothurien. Extr. Bull. Harv. Mus. Comp. Zool., Vol. XXIV, 1893. From Alexander Agassiz.

Lydston, G. F. and E. S. **Talbot**.—Studies of Criminals. Etxr. The Alienist and Neurologist, 1891. From the authors.

Mercer, H. C.—Discovery of Ancient Argillite Quarries on the Delaware. Extr. Sci. June, 1893. From the author.

Merriam, C. H.—Two New Wood Rats from the Plateau of Arizona (*Neotoma pinetorum* and *N. arizonae*), With Remarks on the Validity of the Genus Teonoma of Gray. Extr. Proceeds. Biol. Soc. Wash., Vol. VIII, 1893. From the author.

Morris, J. K.—Random Thoughts on Local Landmarks. Extr. Proceeds. Staten Island Nat. Sci. Ass. 1892. From the author.

Morse, E. S.—A Curious Aino Toy. Extr. Bull. Essex Inst., Vol. 25, 1893. From the Essex Inst.

Newton, A. and Hans **Gadow**.—A Dictionary of Birds. Pt. I. Pt. II. London, 1893. From Prof. Newton.

Nickerson, W. S.—The Development of the Scales of Lepidosteus. Bull. Mus. Comp. Zool. Harv. Coll., Vol. XXIV, 1893. From Alexander Agassiz.

Ninth Annual Report of the Commissioners of the State Reservation at Niagara for the Fiscal Year from Oct. 1, 1891, to Sept. 30, 1892. From G. H. Green.

Pavlow, M.—Le Développement des Equidæ. Moscow, 1883. From the author.

Penhallow, D. P.—Notes on Erian (Devonian) Plants from New York and Pennsylvania.——Notes on *Nematophyton crassum.* Extrs. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Inst.

Prosser, C. S.—The Upper Hamilton and Portage Stages of Central and Eastern New York. Extr. Am. Journ. Sci., Vol. XLVI, 1893. From the author.

Report of the Commissioner of Education for the year 1889–90. Washington, 1893.

Richmond, C. W.—On a collection of Birds from Eastern Nicaragua and Rio Frio, Costa Rica, with notes; and a description of a supposed New Trogon. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Inst.

Ridgway, R.—Descriptions of some New Birds collected on the Islands of Aldabra and Assumption, northwest of Madagascar, by Dr. W. L. Abbot. Extr. Proceeds. Natl. Mus., Vol. XVI, 1893. From the author.

Rose, C. Dr.—Ueber die Zahnentwicklung der Crocodile.——Ueber den Zahnbau und Zahnwechsel von Elephas indicus. Abdruck aus den Morphologischen Arbeiten, Dritter Band Zweites Heft, 1893.——Ueber die Zahnentwickelung von Phascolomys wombat. Sitzungsb. der k. preuss. Akad. der Wissensch. zu Berlin, 1893.——Ueber die Zahnentwicklung des Menschen, Seperatdruck aus Schweizerische Vierteljahrsschript für Zahnheilkunde, Band II, 1892.——Ueber die Nicht Existenz

der sogenannten Weii'schen Basal-schicht der Odontoblasten.——Ueber Zahnban und Zahnwechsel der Dipnoer.——Ueber die Zahnentwicklung vom Chamaelon.——Ueber die Verwachsung von retinirten Zahnen mit dem Kieferknochen.——Ueber das rudimentare Jacobson'sche Organ der Crocodile und des Menschen. Abdruck aus Anat. Anz. Jahrg., 1893. From the author.

SHUFELDT, R. W.—A Group of Moqui Girls. Extr. The Great Divide, April, 1893. From the author.

SMITH, E. A.—The Clays of Alabama. Extr. Proceeds Alabama Industrial and Scientific Soc. No date given. From the author.

Special Catalogue of the Collective Exhibit of Scientific Instruments and Appliances exhibited by the Deutsche Gessellschaft für Mechanik. und Optik Berlin. Berlin, 1893.

STEHLIN, H. G.—Zur Kenntniss der Postembryonalen Schädelmetamorphosen bei Wiederkauern. Inanguraldissertation zur erlangung der Doctorwürde einer hohen philosophischen Facultat der Universität Basel. Basel, 1893. From the author.

STEJNEGER, L.—On the Status of the Gray Shrike, collected by Capt. Blakiston, in Yezo, Japan. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the author.

THORPE, F. N.—Benjamin Franklin and the University of Pennsylvania. Bureau of Ed. Cir. Inf. No. 2, 1892. From the Bu. of Ed.

WARD, S. F.—Some Social and Economic Paradoxes. Extr. Am. Anthrop. 1893. From the author.

WELLS, J. B.—The Reason Why the Colored American is not in the World's Columbian Exposition. Chicago, 1893, From the author.

WILLSON, E. B.—Sermon in Memory of Henry Wheatland, M. D. Salem, 1893. From the Essex Institute.

WOODWARD, A. S.—Sketch of the Life and Works of James William Davis, F. L. S., F. G. S., F. S. A. Extr. Geol. Mag. Sept. 1893. From the author.

RECENT LITERATURE.

The second and concluding part of J. Roth's Allgemeine und Chemische Geologie[1] completes the valuable set of volumes the first two of which have proven such a boon to chemical and petrograpical geologists. That portion of the volume before us has been edited by the author's daughter, who has attempted to present the subject matter contained in it as nearly as possible in the form in which it would have appeared had her father lived to complete his work. The title of the book describes the nature of its contents. The discussion relating to the weathering of rocks comprises 59 pages, on many of which are found analyses that serve to illustrate the subject. Seventy-two pages are devoted to the decomposition of rocks through the influence of volcanic and other examinations from beneath the surface of the crust and thirty-two pages deal with rock distintegration consequent upon temperature changes, the action of organisms, and the effects of wind and water. Three appendices to the three volumes follow, and to each there is added an excellent index. The brochure just issued, like all the others that have come from the pen of its author, is a masterly and thorough treatment of the subject of which it treats. It is a fitting capstone to the excellent monument which the authors reared to himself during the concluding years of his life. It is so replete with interesting information that it must prove a necessity to every student of rocks. W. S. B.

Our Household Insects.[2]—Under the title Mr. Edward A. Butler has written a book which is decidedly better as regards accuracy coherence and scientific value than the usual popular works on entomology. Eighteen chapters are utilized to discuss a great variety of household insects—many of which in America at least could only rarely be viewed in the light of "pests": the list includes wood boring, club-horn and long-horn beetles, meal-worms, ants, wasps, horn-tails, clothes moths and meal moths, crickets and ear-wigs, flies of many kinds including gnats, midges and mosquitoes, the flea and bed-bug, the book-louse and "silver-fish" and lastly human Pediculi. Besides a consider-

---

[1] Allgemeine Geologie, von Justus Roth. 2te Abt. Verwitterung, Zersetzung und Zerstörung der Gesteine. Nachträge. Berlin. W. Hertz., 1893. Pp. 211–530 and ix.

[2] Our Household Insects: An Account of the insect pests found in dwelling-houses. By Edward A. Butler, Longmans, Green, and Co.

able number of fair illustrations in the text, there are seven page-plates showing photographic enlargement of various insects.

Horns and Hoofs[3].—This octavo volume of 411 pages is a reissue in a collective form of articles which have appeared from time to time in the *Field* and *Land* and *Water*. The animals come under the designation of "big game," and include the wild oxen, sheep and goats, the Asiatic and African antelopes, the Asiatic and South American deer, the wild pigs, and the rhinoceroses, ancient and modern. In some of the chapters all the members of particular groups are discussed, in other cases, while the geographical distribution of all given, the author limits the full description to the more important members. The relations existing between the different groups and the past distribution of each particular group are treated of more at length than is customary in the majority of sporting works. In fact the book rises much above the general level of this class, as it could not fail to do as the work of Dr. Lydekker, who is one of the most competent of modern zoologists.

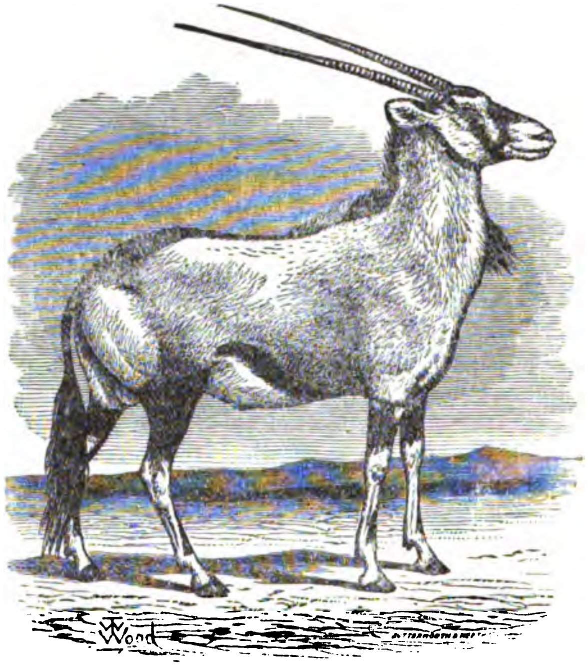


Fig. 1. *Oryx gazella*, the gemsbok of Africa.

---

[3] Horns aand Hoofs or Chapters on Hoofed Animals. By R. Lydekker. Horace Cox; The Field Office, Windor House. London, 1893.

His long residence in India gives him especial authority on the Mammalia of that region, and we accordingly find his descriptions of some of the little known species of the oriental mountain ranges to supply a long feet desideratum. These remarks are especially applicable to the wild species of sheep and goats. We find the work lacks symmetry in the inclusion of the rhinoceroses while it omits the tapirs and horses; and a strictly scientific limitation would include also the Proboscidia. Perhaps these forms can be added in a future edition. In any case it is a book which no sportsman or naturalist can not be without. It is illustrated by 82 excellent cuts. Through the courtesy of the publisher, we are able to reproduce two of them.

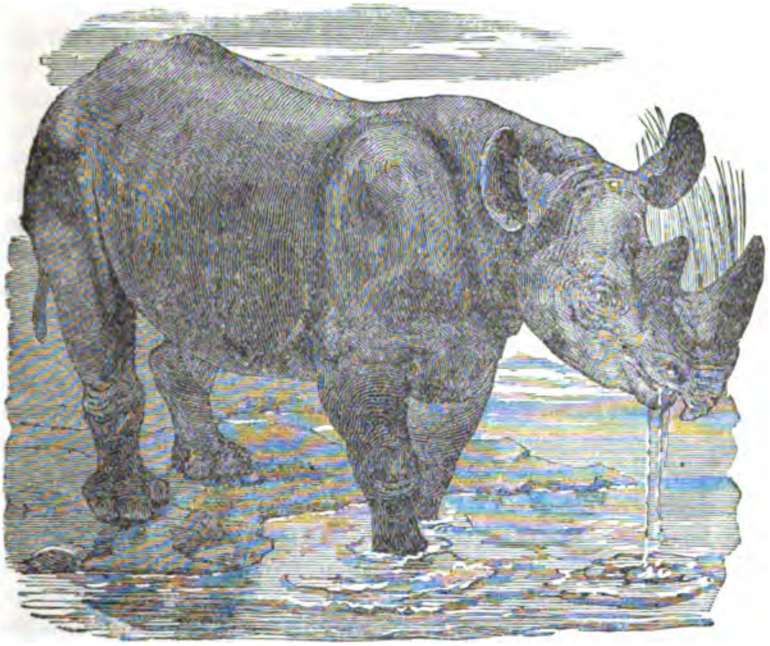


Fig. 2. *Atelodus bicornis;* the common African rhinoceros.

General Notes.

GEOGRAPHY AND TRAVELS.

The Ascent of Mount St. Helens.—The following abstract of an account of the ascent of Mount St. Helens by Mr Fred. G. Plummer, prefaced by a brief history of its recent eruptions, appeared in the December number of *Scientific American:*

"St. Helens has shown considerable activity in recent times. In August, 1831, there was an uncommonly dark day, which was thought to have been caused by an eruption of a volcano. The whole day was nearly as dark as night, except for a slight red, lurid appearance, which was perceptable until near night. Lighted candles were necessary during the day. The atmosphere was filled with very light ashes, like the white ashes of wood. The day was perfectly calm. There were no earthquakes or rumblings. After the ash clouds had cleared away it was seen that the pure white snow upon St. Helens was browned by the fall of ashes. It is also said that lava flows took place at that time."

"In October, 1842, St. Helens was discovered all at once to be covered with a dense cloud of smoke, which continued to enlarge and move off in dense masses to the east, filling the heavens in that direction. When the first volume of smoke had cleared away it could be seen distinctly from various parts of the country that an eruption had taken place on the north side of St. Helens, a little below the summit, and from the smoke that continued to rise from the crater it was pronounced a volcano in active operation. When the explosion took place the wind was morthwest, and on the same day, extending from thirty to fifty miles to the southwest, there fell showers of dust or ashes, which covered the ground in some places so as to admit of its being gathered in quantities."

"On November 23, 1843, St. Helens scattered ashes over the Dalles of the Columbia River, fifty miles away, and burned continuously until February 16, 1844. Dense masses of smoke rose from the craters in immense columns, and in the evenings the fires 'lit up the mountain side with a flood of soft yet brilliant radiance.'"

"Having determined to investigate the most active volcano of Washington, we left Tacoma by the midnight train, August 10, 1893,

with packs containing necessaries for the trip and the instruments for observing and recording all we were to see."

"When we reached the mountain, with the aid of a glass I was able to map out a route to the larger of the craters which would not cross any of the great crevasses in the ice slopes. Our ascent began immediately, and in less than an hour became very steep and in places dangerous. Our progress was checked by an enormous cañon, several hundred feet deep, which appeared a counterpart of the great cañon of the Yellowstone. Its formation showed several old lava flows, which, being firmer than the cinders and broken rock, in most places overhung the walls of the cañon and made descent out of the question. The great glacier at its head was fully 100 feet deep at the foot, and was ploughing its way into a huge terminal moraine of small rocks. We could plainly hear the rocks grinding together as the great body of ice slowly forced them down the cañon. This great glacier headed in the ice cap at the summit of the mountain, and, although it looked steep and slippery, we decided to try the route. It was then 10 o'clock in the morning—a bad time to climb ice slopes aud snow fields—but we had been gone from Tacoma nearly a week and had only provisions for two more days. We had proceeded but a short distance cutting steps in the steep ice slope, when a bombardment of rocks warned us that our route was to be a dangerous one. The surface of the glacier seemed a sheet of ice clear to the summit, and down its slippery surface came rocks large and small as fast as the noonday sun melted the ice and snow which held them near the top."

"Imagine a toboggan slide about three miles long, starting nearly 10,000 feet above the sea with an initial grade of forty-five degrees. The speed of the rocks as they passed us was terrific. They whirled at such a rate that they seemed spherical in form, and as they flew down the slope seemed only to touch the high places in the slightly wavy surface of the glacier, making a metallic sound as they clipped the ice into a cloud which trailed them like a comet's tail. Here and there great rocks lay upon the surface of the glacier, probably having been held by a fall of new snow, and now and then one of these flying rocks would strike those which were held by the ice, and, amid a shower of sparks and chips, would bound into the air fifty feet or more, still whirling like a buzz saw and giving out a sound which I cannot describe. All this would have been very entertaining if so many of the flying rocks had not passed near us."

"We were exposed to this danger for over an hour while climbing a quarter of a mile, and to say that we were all thoroughly frightened

would not do the rocks justice. When at last we reached a place of comparative safety, we were too much much awed to speak."

Source of the Mackenzie River.—Up to the present time the Mackenzie River has never been traced to its head, and its source has only been known from Indian report. The mystery has been solved by Mr. R. G. McConnell of the Dominion Geological Survey, who has just returned from a four months' exploration trip in those regions. The following account of his trip is taken from the *Vancouver News-Advertiser*:

"Mr. McConnel arrived in British Columbia from Ottawa in June, and started out on his trip fron Quesnelle on the 9th of that month. The party numbered six in all and consisted of himself, his assistant, Mr. Russel, two whites he engaged at Quesnelle and two Indians. From Quesnelle the party proceeded in canoes up the Frazer to Giscome Portage. This is seven and a half miles long, aud after crossing it they proceeded down Crooked River to Fort McLeod. Their route then lay down Parsnip River to the forks, where Findlay River meets the Parsnip and gives birth to Peace River."

"On reaching Findlay River Mr. McConnel really commenced his summer's work, as the chief object of his trip was to explore that river and, if possible, the Onimeca also. Mr. McConnel accordingly went up Findlay River to its junction with the Onimeca, and followed the latter river to its head, returning down it again to the same spot. This river is easy navigable on the upper portion, but in the first thirty miles it falls over 500 feet, and is consequently extremely rapid and difficult to ascend. Mr. McConnel then proceeded up the Findlay River."

"Whites had been up the Onimeca River previous to him, as at one time that was a famous gold country, but Mr. McConnel and his party were the first whites to eve ascend the Findlay River to its head. The river is about 250 miles long and is navigable for the greater portion of the way in canoes, though owing to the rapids the party had to proceed the last fifty miles on foot, an arduous proceeding, owing to the roughness of the country. The country is very mountainous, and though at the lower part of the river the valley is six miles wide, the mountains come right down to the water's edge in the upper portion."

"At its mouth the Findlay is about as wide as the Frazer at Quesnelle. It is not deep except in the cañons, where the current is very strong, and, owing to numerous rapids and eddies, progress is very slow. At the head of Findlay River is a lake known in the Indian

tongue as Lake Fehutade, which, being interpreted, means "narrow waters between mountains." This lake is the real source of the Mackenzie River. It is between twenty-five and thirty miles long and not more than a quarter of a mile wide, and is enclosed by high mountains. Around the edge of the lake are glaciers, and the scene is a very pretty one. The mountains rise 5000 to 6000 feet above the lake, while they are some 9000 feet above the level of the sea. After exploring the lake Mr. McConnel started on his homeward journey about the end of August, and it was none to soon, as ice began to form on the river, and while on the Parsnip the party experienced a snowstorm."

GEOLOGY AND PALEONTOLOGY.

A Food Habit of the Plesiosaurs.—Mr. S. W Williston reports finding a number of pebbles in such a position with respect to the bones of a Plesiosaur discovered in the Niobrara chalk in Kansas that the conclusion is irresistible that the stones had been in the stomach of the reptile. They had probably been swallowed to aid in digestion, a custom still in vogue among the Crocodiles. Some of the pebbles were attached by the original soft limestone matrix to the ribs and thoracic vertebræ, so that there could not be a shadow of a doubt as to the contemporaneity of deposition.

The saurian is one of the largest of the order, measuring when alive about fifty feet. The pebbles, 125 in number, are extremely hard, consisting almost wholly of silica, varying in weight from 1 to 170 grams. They are conspicuous in color, either white, black or pink, and show a great amount of abrasion, and probably came from the shores of the Benton sea.

From the uniformity of shape among the smaller ones, their number, and their color, Mr. Williston is inclined to think they were not merely water-worn pebbles, accidentally swallowed, but they had been selected by the saurian for a purpose, and that their present shape is owing to their prolonged use as "gizzard-stones" in the animal's stomach. (Trans. Kansas Acad. Sci., Vol. XIII, 1891-92.)

The Texas Region.—In a recent paper on the physical geography of Texas, R. S. Tarr embodies the results of his personal observation with the published geological work of others in the same region and summarizes the geological history of Texas as follows:

"The evolution of the Texas region began with an old Paleozoic or Pre-Paleozoic mountainous land which was denuded at the beginning of Carboniferous times to an old topographic form, not unlike the hilly region of southern New England. The Carboniferous beds were added to this land, by elevation, first as a costal strip, even before the end of the Carboniferous. A gathering in of shore lines formed a great interior sea, later a completely land-locked dead sea in which Permian beds were deposited; and from the close of the Permian to the beginning of the Cretaceous there was a period of denudation during which the younger Paleozoic beds were reduced to base-level and the older mountainous areas still farther degraded. A rapid subsidence lowered

the entire region below the Cretaceous sea; then at the close of the Cretaceous the land was elevated, possibly by the renewal of the mountain-building forces of the central area. The Rocky Mountain uplift caused an uptilting, raising the land still higher, and adding the Tertiary coastal strip to the Cretaceous. A later uplift added the costal prairies and a recent slight subsidence has completed this record of change, and has given us the Texas region." (Proceeds. Phila. Acad., 1893.)

Terrestrial Submergence Southeast of the American Continent.—At the meeting of the American Association for the Advancement of Science, Madison, 1893, Dr. J. W. Spencer brought before the Society evidence of epeirogenic movements in the Antillean region, in very recent geologic times, amounting to two and one half miles of vertical subsidence of great land areas. The author's recent studies of valleys among the southern Appalachian mountains convinces him that these valleys are independent of mountain movements, and are due to erosion, either atmospheric or by running water. The valleys and channels among the Greater Antilles, and between them and the continent, are an exact reproduction of the southern Appalachian land valleys. From this analogy the author concludes that both the land and submerged Antillean valleys were of a common subaerial origin.

The submerged valleys and channels are of varying depths, the author cites examples ranging from 3,738 feet to 14,000 feet, and even in one case 20,000 feet is reached. The submergence indicated by the channels means extensive continental land-movements, which were not violent enough to obliterate the former land topography. This great continental depression diminished to the north, so that the southern states have been only partly submerged.

The great continental extension was during late Cenozoic time, if McGee's determination of the age of the Lafayette formation be accepted. The drainage of this area was largely into the Pacific, or its embayments. The watershed between the Atlantic and Pacific is still represented by the mountains of Cuba, Haiti and the Windward islands. (Bull. Geol. Soc. Am., Vol. 5, Nov., 1893.)

Tropical Miocene Fossils in Siberia.—A small collection of fossils collected by Dr. William Stimpson in northern Siberia, about 62° north latitude, on an arm of the Okhotsk sea, has been reported upon by Dr. Wm. H. Dall. The collection comprises six species of molluscs, of which five are new. In his general conclusions the author

remarks that "formally the species point to a distinct analogy with those of the China and Japan seas, and like the existing fauna of those seas, they indicate bonds of relationship with the west coast of Africa and the coast of Australia."

The matrix of the fossils determines them to be of Miocene age, and as the fauna indicated by them lived in waters as warm as the Japan sea, the annual mean temperature of the Okhotsh sea in the era in which these fossils flourished must have been about 60° F., a difference of 30° to 40° F. from that of the present time. (Proceeds. U. S. Natl. Mus., Vol. XVI., 1893.)

Arctic Geology.—According to Sir Henry Howorth the Arctic lands, during the Pleistocene period, instead of being overwhelmed by a glacial climate, were under comparatively mild conditions. Since Plistocene times the climate has been growing more and more severe. The author bases this conclusion on a study of the Arctic flora as displayed in Greenland, Spitzbergen, and the uncovered moraine of the great glacier in Alaska, and also upon certain faunal facts. He cites evidence to show that the present flora of Greenland is undoubtedly a relic of an old flora which has survived in favorable localities, and not an importation since Glacial times. The same is true of the Spitzbergen flora. The discovery of a colony of sea-cows on Behring's Island seems to indicate a recently milder climate in that region. The peculiar types of northern migratory birds suggests that at no very remote period they lived the year round in their present breeding places in Northern Siberia, Greenland and Spitzbergen, and that it is the present ever increasing cold that leads them to migrate in search of warmth and food. In short, the only Glacial climate we are warranted in supposing to exist in the Arctic lands is that which is now current, and it is the product of changes in the level of the earth's crust since Plistocene times. (Geol. Mag., Nov., 1893.)

An Extinct Lemuroid from Madagascar.—At a recent meeting of the Royal Society of London Dr. Henry Woodward read a communication from Mr. Forsyth Major concerning a huge fossil Lemuroid from Madagascar, to which we referred in the Nov. number of the NATURALIST (p. 1002). The following report is given in *Nature* , July 20, 1893.

"It is now forty-two years since Geoffroy Ste-Hilaire announced to the French Academy of Science the discovery of gigantic eggs and a few bones of Æpyornis from superficial deposits in the Island of

Madagascar, anticipating that a rich fauna of extinct vertebrata would be speedily forthcoming. Little has, however, been added to our knowledge since 1851 to the present time. In addition to the remains of a Crocodile, two Chelonians, and a Hippopotamus, first discovered by Grandidier, the number of distinct forms of Æpyornis is now rapidly increasing, and promises to rival in variety the New Zealand species of Dinornis, whilst the disclosure of a rich mammalian fauna seems only waiting to reward the carrying out of systematic exploration.

"Four collections of sub-fossil vertebrates, from various regions of Madagascar, have recently been acquired by the British Museum of Natural History. Amongst one of these sent over by Mr. J. T. Last is a somewhat imperfect skull of strange appearance obtained with numerous fragmentary Chelonian, Crocodilian, Hippopotamus and Æpyornis, remains from a marsh at Ambolisatra on the southwest coast of Madagascar. For this remarkable fossil Dr. Major proposes the name *Megaladapis madagascariensis,* and the establishment of a distinct family of the sub-order Lemuroidea, of which Megaladapis appears to be a much specialized gigantic member, being approximately three times the size of the cranium of the largest existing Lemurid.

"The salient features of the skull are the enormous lateral development of the anterior inter-orbital portion of the frontals, extending over the small, thick-walled tubular orbits. The post-orbital frontal region is comparatively narrow and elongate, and separated by a slight contraction from the equally narrow parietal region, bearing a thick and flattened sagittal crest. The brain-case is low, short and narrow, and placed at a considerable higher level than the elongate facial portion. Both the cranial and facial portion are somewhat bent upwards, the former posteriorly, the latter anteriorly. A striking general character is the remarkable pachyostosis (thickening) of the cranium.

"The author points out that, in its peculiar features, this skull only carries to an extreme, characters which are present, but in a much lesser degree, and in varying gradations, in the different members of the Lemuroidea, both recent Lemuridae, and extinct Adapidae. In the very simple pattern of the molars, the superior of which are of the pure tritubercular type, Megaladapis approaches closely to the Malagasy Lemurides, Lepidolemur, and still more to Chirogaleus.

"The diminutive size of the brain-case (comparable only with what we find amongst the Marsupialia and the Insectivora) is viewed by the author, in this instance, as a degeneracy, other characters being equally indicative of a retrogressive evolution undergone by this Lemuroid.

"It is strongly insisted upon, generally, that 'low' organization in Mammalia is by no means always synonymous with 'primitive' organization, and that retrogressive evolution is more frequently to be to be met with amongst Mammalia than is generally admitted.

"As regards the geological age of Megaladapis and its associated fauna, one of whose members the *Crocodilus robustus*, is still living in the lakes of the interior, evidences of various kinds goes far to prove that these sub-fossil remains represent a fauna which was living at a comparatively very recent period, and that man himself was contemporary with it, and in part responsible for its destruction.

"The author adduced evidence in support of the proposition that an older Tertiary vertebrate fauna will ere long be forthcoming in Madagascar."

Geological News. General.—In a brief report on the organic remains obtained from a deep well near Galveston, Texas, Mr. G. D. Harris compares the fossil shells wlth the recent ones of the Atlantic and Pacific shores of America and the fossil faunæ of the Atlantic slope, including that of the West Indies. The relationships are shown in a bathymetric table. The collection comprises 77 species, of which 20 are new. In addition to the marine forms enumerated in the table, the following fresh water species were obtained: *Polygyra hindsii* Pfr., *Amnicola*, not distinguishable from *peracuta*, and a *Planorbis* allied to *P. vermicularis* from the Lake of the Woods. (Fourth Ann. Rept., 1892, Geol. Surv., Texas.)

Paleozoic.—A new gasteropod, *Loxonema winnipegense* from the Trenton limestone of Manitoba is described and figured by Mr. J. F. Whiteaves. The author considers it of interest on account of its strikingly close similarity to some of the most typical Jurassic species of Pseudomelaniæ. (Canadian Rec. Sci., 1893.)

In regard to the use of the term "Catskill," Mr. J. J. Stevenson avers that, in nine-tenths of the area in which this series is exposed within the Appalachian Basin, the Chemung is the important portion of the series. Catskill is simply epochal but "Chemung" carries with it the conception of those physical and biological characteristics which mark the closing period of the Devonian. For which reasons, Chemung should be used to designate the whole group, retaining Catskill in its original and local signification only. (Amer. Journ. Sci., Nov., 1893.)

Mesozoic.—In a contribution to the "Invertebrate Paleontology of the Texas Cretaceous," Mr. F. W. Cragin describes 168 species dis-

tributed as follows: Cœlenterata, 1 sp. nov.; Echinodermata, 32, of which 17 are new; Molluscoidea, 2 sp. nov.; Brachiopoda, 1 sp. nov.; Mollusca, 132, of which 82 are new. The text is illustrated by 46 plates of drawings, some of which were made by the writer. (Fourth Annual Rept., 1892, Geol. Surv., Texas.)

The discovery of fossil Cretaceous plants at Glen Cove, and various other localities in Long Island, by Mr. Arthur Hollick, together with the collections made by Mr. David White in Gardiners Island, Block Island, Center Island and Marthas Vineyard, have enabled Mr. Hollick to trace the continuity of the cretaceous strata from New Jersey through Staten and Long Islands to Marthas Vineyard, and to demonstrate beyond question that the theory of Mather and subsequent observers in regard to the eastward extension of the cretaceous formation was correct, and emphasizes the probability that certain limited areas of the New England coast could also be referred to that horizon. (Trans. New York Acad. Sci., Vol. XII, 1893.)

Two new forms of the Pycnodont genus Anomœdus, *A. superbus* and *A. willetti* from the upper English Cretaceous are described by A. Smith Woodward. This genus was described by Forir, but his definition was based solely upon the arrangement of the splenial teeth. The new material enables Woodward to make the definition more satisfactory. In the same paper the author describes the splenial dentition of two new species of Cœlodus, *C. inaequidens* and *C. fimbriatus.* (Geol. Mag., Nov., 1893.)

In some notes on a few fossil leaves from the Fort Union group of Montana, Mr. F. H. Knowlton describes a new species, *Populus meedsii,* evidently related to *P. heerii* Sap. from the Eocene at Florissant, Colorado, and which has for a living analogue *P. angustifolia* James, a species living along streams from New Mexico and Colorado to California and Washington. (Proceeds. U. S. Natl. Mus., Vol. XVI, 1893.)

Cenozoic.—In a study of the rocks of Carmelo Bay, California, Mr. A. C. Lawson finds no evidence for Whitney's statement that Miocene rocks are here invaded by a mass of granite. The rocks, consisting of sandstone and shales, are probably Eocene, and rest upon a worn and eroded surface of granite. The supposed metamorphic rocks are laminated volcanic flows. Miocene formations are abundantly developed but do not extend down to to the shores of the bay. (Bull. Univ. California, Vol. I, 1893.)

Mr. R. A. F. Penrose records the discovery of a Plistocene manganese deposit near Golconda, Nevada. The ore occurs as a lenticular mass in a soft calcareous tufa, and probably represents a local precipitation from spring waters. The position and nature of the ore show that the bed was laid down in shallow water and subsequently covered over by a tufa deposited from the supersaturated lake water. (Journ. Geol., Vol. I, 1893.)

MINERALOGY AND PETROGRAPHY.[1]

The Granite of Santa Lucia, California, and a New Rock Variety Carmeloite.—The Santa Lucia Mountains[2] in the vicinity of Carmelo Bay, California, consist largely of a porphyritic granite whose phenocrysts of glassy orthoclase are corroded with inclusions of cloudy orthoclase, plagioclase, quartz, biotite, apatite and muscovite, which substances also constitute the groundmass of the rock. The striking feature of the inclusions is that their different areas are not only uniformly orientated with respect to each other, but they are also definitely orientated with reference to their host. They lie in certain definite planes within the phenocrysts, and their crystallographic axes are definitely arranged with respect to the axes of their hosts. The quartzes all lie with their vertical axes nearly perpendicular to the basal plane of the orthoclase, consequently in sections of the phenocrysts cut parallel to the basal pinacoid every included quartz grain exhibits the axial figure. Another feature worthy of notice is the tendency of the inclusions to idiomorphic forms, whereas, the same minerals in the rock's groundmass are always allotriomorphic. The facts of the idiomorphism of the inclusions and their definite orientation suggest to Lawson that these and their hosts are of contemporaneous age. This view is strengthened by the observation that many inclusions on the edges of the phenocysts have grown out into the surrounding matrix, in which, as has already been noted, the components are the same as those occurring as inclusions, but are much larger than these, and are allotriomorphically developed. This granite is cut by dykes of fine-grained aplite.

The rock to which the author has given the name Carmeloite, is a young volcanic, marked by all the characters of a recent lava. It is probably younger than the Monterey series of the Miocene, and older than the newer terrace formations of the region. Under the microscope the rock is seen to consist of phenocrysts of iddingsite, plagioclase and often augite in a matrix composed of a felt of small, lath-shaped plagioclase and granules of magnetite and pyroxene, lying in a glass containing numerons feebly polarizing globulites. There are six areas of the rock in the Carmelo Bay district, the occurrences differing mainly in the quantity of glass present, the presence or absence of

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] A. C. Lawson, Bull. Dept. Geol. Univ. of Cal., Vol. I, p. 1.

iddingsite in the groundmass, and of augite among the phenocrysts. The occurrences differ also in their chemical composition, their silica contents varying between 52.83 % and 60.00 %. The analysis of one specimen (Sp. Gr. = 2.51--2.54).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	Ign.	Total
60.00	19.01	3.20	.68	tr.	4.10	1.28	2.79	6.97	4.30 =	102.33

Since the rock contains too much SiO_2 for a basalt, and too little for andesite, and because of the prominence of iddingsite as one of its essential components, the author prefers the new name, Carmeloite, to any already in use among petrographers.

The Ancient Rocks of Southern Finland.—In the German resumé of his article on the old rocks of southern Finland, Sederholm[3] divides these into two groups—the Archean and the Algonkian, and the first of these groups into two sub-groups. The older Archean consists of phyllites, gneisses, micaceous and other schists and granular limestone, cut by granite and diorite. All the members of the series have been subjected to dynamic metamorphism on an enormous scale. The schists are supposed to have originated both in sedimentary and in erruptive rocks. The younger Archean schists are phyllites, mica-schists, sandstone-schists, and a greenstone schist that was originally a uralite porphyrite occurring as a surface flow. These are cut by a red granite that is sometimes porphyritic and often pegmatitic. It shows no evidence of having been subject to great pressure, but nevertheless it is foliated—a consequence, according to the author, of flowage. The Algonkian rocks are all fragmental, and above them are the Rapakivi granite and a diabase, both of which are effusive. A younger olivine diabase and a panidiomorphic gabbro are also thought to be volcanic flows.

Petrographical News.—Smith[4] has discovered that the supposed peridotite[5] of Manheim, N. Y., is an alnoite in which there is no pyroxene. It contains a large quantity of melilite in the typical forms, but the mineral is positive in the character of its double refraction, like the artificial melilite made by Vogt. Incidentally the author mentions that positive melilite exists also in the nepheline basalt of Wartenburg, Bohemia, and in the alnoite from Alno, Sweden.

[3] Fennia, 8, No. 3, p. 138.

[4] Amer. Journ. Sci., XLVI, p. 105.

[5] Cp. AMERICAN NATURALIST, Sept., 1892, p. 769.

About 600 miles north of the Falkland Islands in the South Atlantic, a fall of volcanic dust occurred on May 26, 1892. Palache,[6] who has examined some of the material, finds it to consist of fragments of glass and pieces and crystals of orthoclase, plagioclase, green hornblende and magnetite, with a very small quantity of what appears to be pyroxene. The character of the dust is thus andesitic.

New Minerals..—*Iddingsite* has been known for some time as a component of certain eruptive rocks from the far west, but not until Lawson[7] discovered it in the carmeloite of California, had its characteristics been carefully enough investigated to warrant its receiving a name. As described by Lawson, iddingsite occurs as a phenocryst with well-defined crystal outlines. It is of a bronzy color, has a very perfect cleavage and a hardness of 2.5. Its cleavage lamellae are brittle. Before the blow-pipe the mineral is infusible, though it loses water when heated. It is decomposed by acids after long treatment, but loses only its dark pigment, without alteration of its optical properties, when gently heated with hydrochloric acid. Maximum density = 2.839. Its crystals possess in thin section the habit of olivine. If the cleavage is regarded as pinacoidal, the other crystallographic faces are the prism, with a prismatic angle of about 80°, and another pinacoid, both of which are perpendicular to the cleavage. The elongation of the crystals is in the direction of the second pinacoid. If the cleavage is regarded as parallel to the macropinacoid, b is in the cleavage plane, a is at right angles to it, and c is parallel to the elongation of the crystals. The plane of the optical axes is the brachypinacoid, and the mineral is orthorhombic and negative; $a = A$, $b = B$ and $c = C$. In thin section the color varies between yellowish green and chestnut brown, and the absorption is strong parallel to c. The absorption formula is $C > B > A$. The mean index of its fraction is low, and the double refraction strong. Qualitative tests showed the presence of silicon, iron, calcium, magnesium, sodium and water. In spite of the resemblance of its crystals to those of olivine, the author regards it as most probably an original separation from the magma that yielded the carmeloite.

Mackintoshite is the name given by Hidden and Hillebrand[8] to the original material from which the alteration product *thorogummite*[9] is derived. Only a very small quantity was available for study. This is

---

[6] Amer. Geol., June, 1893, XI, p. 422.

[7] Bull. Dept. Geol. Univ. of Cal., Vol. 1, p. 31.

[8] Amer. Jour. Sci.. XLIV, 1890, p. 98.

[9] AMERICAN NATURALIST, Jan., 1893, p. 72.

described as opaque and black. Its hardness is 5.5 and density 5.438. Its crystals are square tetragonal prisms and pyramids like those of zircon. It is infusible before the blow-pipe, and is insoluble in the simple acids. It dissolves readily in a mixture of nitric and sulphuric acid, and in aqua regia. In nine-tenths of a grain of material, the following constituents were found:

SiO_2	UO_2	ZrO_2(?)	ThO_2	$La_2O_3.Y_2O_3$	PbO	FeO	CaO	MgO	K_2O	$(NaLi)_2O$	P_2O_5	H_2O
13.90	22.40	.88	45.30	1.86	3.74	1.15	.59	.10	.42	.68	.67	4.81

The new mineral thus differs from thorogummite in the possession of one molecule of thoria.

Canfieldite is a new germanium mineral from somewhere in Bolivia.[10] Its crystallization is regular, small crystals being bounded by the octahedron and the dodecahedron. The hardness is 2.5, density 6.266, lustre metallic and color black with a purplish tinge. Its streak is grayish black and degree of fusibility 1.5 to 2. Upon analysis, the following result was obtained:

S	Ge	Ag	Fe. Zn.	Ins.		Total
17.04	6.55	76.05	.13	29	=	100.06

which corresponds to the formula $Ag_8\ Ge\ S_6$. A re-analysis of the Freiberg argyrodite yields results that accord better with the formula above-given than with the formula $Ag_6\ Ge\ S_5$ proposed for it by its discover, Winkler.[11] Both minerals have the same composition, consequently, since argyrodite is monoclinic, they are dimorphs.

Marshite.—This copper iodide[12] occurs at Broken Hill, New South Wales, as tiny crystals implanted on a siliceous cerussite. The crystals are probably hemihedral-tetragonal. In color they are reddish-brown, in lustre, resinous. They possess an orange yellow streak, are transparent and brittle.

Kehoeite, from Galena, Lawrence Co., S. D., forms seams and bunches in the galena of the Merritt mine. The material is white, amorphous and insoluble in water. Its analysis yielded Headden[13] the following figures:

P_2O_5	SO_3	ZnO	CaO	Al_2O_3	Fe_2O_3	MgO	Cl	H_2O	Ins.		Total
26.76	.50	11.64	2.70	24.84	.78	.08	tr.	31.06	1.76	=	100.02

[10] S. L. Penfield, Amer. Jour. Sci., XLVI, 1893, p. 101.

[11] Jour. f. prakt. Chem., XXXIV, 1886, p. 177.

[12] C. W. Marsh, Proc. Roy. Sci. N. S. W., XXVI, p. 326.

[13] Amer. Jour. Sci., XLVI, p. 22.

corresponding to $R_3(PO_4)_2+2\ Al_2(PO_4)_2+2\ Al_2(OH)_6+21\ H_2O$.

Neptuneite and *Epididymite* are associated[14] with aegirite, arfvedsonite, eudialyte, etc., near Julianehaab, Kangerdluarsuk, Greenland. The former is found as short, prismatic monoclinic crystals, with a perfect cleavage parallel to ∞P. Their color is black in the larger crystals, but deep red brown in the small ones. Their hardness is 5–6, density, 3.234, and composition:

SiO_2	TiO_2	FeO	MnO	MgO	K_2O	Na_2O		Total
51.53	18.13	10.91	4.97	.49	4.88	9.26	=	100.69

These figures correspond to the formula $(\frac{3}{4}\ Na_2+K_2)\ Si_4O_9+(\frac{3}{4}Fe+\frac{1}{4}\ Mn)\ TiO_3$. Epididymite is regarded as a dimorph of eudidymite. It occurs in orthorhombic prisms elongated in the direction of their macroaxes. Their analysis: $SiO_2 = 73.74$; $BeO = 10.56$ $Na_2O = 12.88$; $H_2O = 3.73$, corresponds to the formula for eudidymite, viz.: $HNa\ Be\ Si_3O_8$. Density $= 2.548$.

Franckeite, from near Chocaya, in the Animas District, Bolivia, is an associate of the silver ores of the region. It occurs,[15] as a radial, aggregate, or as a structurelass layer of a dark gray or black substance, that is opaque and soft. Its hardness is about 2.75, and density 5.55. Its quantitative analysis yielded:

Pb	Sn	Sb	S	Fe	Zn	Gangue		Total
50.57	12.34	10.51	21.04	2.48	1.22	.71	=	98.87

while qualitative tests showed it to contain also about .1% of germaniun and a fractional percentage of silver. The mineral is a sulfo-salt of the the formala: $Pb_2\ Sn_2\ S_6 + Pb_3\ Sb_2\ S_6$. It resembles in appearance and in the nature of its components the plumbo-stannite from Moho in Peru, but differs from it in the proportion of its constituents.

Cylindrite owes its name to the cylindrical form that it so commonly assumes. It is described by Frenzel[16] as possessing a dark, lead-gray color and a metallic lustre. It is malleable, has a hardness of 2.5–3, and a density of 5.42. It occurs in cylindrical bodies imbedded irregularly in a granular lamellae mass of the same substance. An analysis of the mineral gave:

Pb	Ag	Fe	Sb	Sn	S		Total
35.41	.62	3.00	8.73	26.37	24.50	=	98.63

---

[14] G. Flink, Geol. För. Förh., XV, 1893, p. 195.

[15] A. W. Stelzner, Neues Jahrb. f. Min., etc., 1893, II, p. 114.

[16] Ib., 1893, II, p. 125.

corresponding to $Pb_6 Sb_2 Sn_6 S_2$. The mineral is easily decomposed by hot hydrochloric and nitric acid, but is scarcely affected by cold hpdrochloric acid. Like franckeite and plumbostannite, it is a South American mineral, occurring, as it does, at the Mina Santa Cruz, Poopó, Bolivia.

Hantefeuillite accompanies crystals of apatite, pyrite, iron and monazite at the apatite mine at Odegärden, Bamle, Norway. It is found in the greenish nodules composed of wagnerite and apatite, that are scattered through the apatite veins cutting gabbro. Michel[17] describes it as forming transparent, colorless monoclinic crystals radically grouped. Its hardness is 2.5 nnd density 2.435. The crystals are all tabular in habit, being elongated parallel to *c*, and flattened to $\infty P \breve{\infty}$. Their optical axes lie in the latter plane, and their optical angle has a value—2Vna = 54° 23′. An analysis gave $P_2O_5 = 34.52$; $MgO = 25.12$; $Cao = 5.71$; $H_2O = 34.27$, corresponding to $(Mg\ Ca)_3 (PO_4)_2 + 8H_2O$, which is the guano mineral bobierrite in which Mg has been in part, replaced by Ca.

Chondrostibian, as its name indicates, is an antimony mineral occurring in grains. It is reported by Igelström[18] from the famous manganese mine Sjogrufran, Grythyttan, Sweden. It is found disseminated as grains through barite, which, with calcite and tephroite, forms a cryptio-crystalline mass. These grains constitute nearly 50% of some of the barite plates to which they impart a brownish tinge. The mineral itself is yellowish-red in color, though in large pieces it appears dark brownish red. It is weakly magnetic, and yields, upon analysis, figures indicating the following composition:

Sb_2O_5	As_2O_5	Mn_2O_3	Fe_2O_3	H_2O		Total
30.66	2.10	33.13	15.10	19.01	=	100.00

corresponding to $3R_2O_3\ Sb_2O_5 + 10\ H_2O$.

---

[17] Bull. d. l. Soc. Franç d. Min., xvi, p. 38.

[18] Zeits. f. Kryst., xxii, p. 43.

BOTANY.[1]

Ellis and Everhart's North American Fungi.—Subscribers to this set have recently received Century XXX of this great distribution of specimens, bringing the number up to 3000. Messrs. Ellis and Everhart are to be congratulated upon having carried their work to this point without a break or serious delay; an achievement never before excelled. May we not hope that they will push forward now toward the fortieth century?

The present volume is a miscellaneous one, including representatives of genera in widely separated families. Thus, there are of *Æcidium* 4 species, *Capnodium* 3, *Cercospora* 11, *Cladosporium* 2, *Cylindrosporium* 3, *Gymnosporangium* 2, *Morchella* 1, *Peronospora* 1, *Peziza* 4, *Phyllosticta* 4, *Puccinia* 7, *Septoria* 6, *Uromyces* 2, besides many others of equally wide relationship.

Of the quality of the specimens nothing need be said. The preceding Centuries have shown that in this regard nothing is wanting. Botanists who are so unfortunate as not to have secured a set of the North American Fungi, will be glad to know that the authors have begun a new set under the name of "Fungi Columbiani," of which they now offer Centuries I and II at six dollars each.—CHARLES E. BESSEY.

A Synopsis of the larger Groups of the Vegetable Kingdom.—The following synopsis represents the results of a careful review of the larger groups of the vegetable kingdom. The Classes are, with few exceptions, those usually recognized by modern authors, but in the first and second their limits have been slightly extended so as to include a comparatively small number of degraded chlorophyll-less forms, the Bacteria and the Phycomycetous fungi.

In like manner, in a few cases, slight changes have been made in the limits of the groups below classes (here tentatively called orders), otherwise they remain essentially as usually outlined. In the attempt to co-ordinate groups it becomes obvious that the "Orders" of the lower plants are equivalent to the "series" of the Angiosperms, according to the nomenclature of Bentham and Hooker's *Genera Plantarum.* At first sight it may seem to be a violent innovation to transfer the term "Order" from *Rosaceæ*, for example, to the great aggregate of forms, the *Calyciflorœ*, yet a careful study

---

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

of the whole system of plants warrants the assertion that these Benthamian "series" are entitled to no higher rank. The so-called "orders" of the manuals are, in fact, no more than families, and these in the flowering plants have become greatly multiplied.

The apetalous families of Dicoyledons are not regarded as constituting a separate group, but are distributed among the Choripetalæ and Gamopetalæ. In both Monocotyledons and Dicolyledons the apocarpous families are regarded as primitive and lower, and the syncarpous as higher: and among the latter the epigynous are regarded as higher than the hypogynous.

SYNOPSIS.

Branch I. PROTOPHYTA (Protophytes; Water-Slimes).

Single cells, or chains of cells, reproducing by fission and endospores.

Class 1. SCHIZOPHYCEAE.	Order Cystiphorae (Blue-green Slimes).
(Fission Algæ.)	Order Nematogeneae (Nostocs, Bacteria, etc.).

Branch II. PHYCOPHYTA (Phycophytes; Spore-Tangles).

Single cells, chains, or masses, the latter sometimes forming a branching plant with rhizoids. Sexual reproduction by the union of two protoplasts to form a single resting-spore (zygospore or oöspore).

Class 2. CHLOROPHYCEAE.	Order Protoccoideae (Green-Slimes, Synchytria, etc.). Order Conjugatae (Pond-Scums, Black Moulds, etc.). Order Siphoniae (Green-Felts, Downy Mildews, etc.). Order Confervoideae (Water-Flannels; etc.).
(Green Algæ.)	
Class 3. PHAEOPHYCEAE.	Order Phaeosporeae (Kelps). Order Dictyoteae. Order Fucoideae (Rockweeds).
(Brown Algæ.)	

Branch III. CARPOPHYTA (Carpophytes; Fruit-Tangles).

Chains, plates or masses of cells, the latter often forming a branching plant with rhizoids. Sexual reproduction (where known) by the union of two protoplasts to form a spore-fruit (sporocarp).

Class 4. COLEOCHAETEAE.	Order Coleochaetaceae (Simple Fruit-Tangles).
Class 5. ASCOMYCETES.	Order Perisporiaceae (Simple Sac-Fungi). Order Tuberoideae (Subterranean Sac-Fungi). Order Pyrenomyceteae (Black Fungi, including lichens). Order Discomyceteae (Cup Fungi, including lichens). Order Uredineae (Rusts). Order Ustilagineae (Smuts).
(Sac-Fungi.)	
"Imperfect Fungi."	Order Sphaeropsideae. Order Melanconieae. Order Hyphomyceteae.
Class 6. BASIDIOMYCETES.	Order Gasteromyceteae (Puff-balls, etc.). Order Hymenomyceteae (Toadstools, etc.).
(Higher Fungi)	
Class 7. RHODOPHYCEAE.	Order Florideae (Red Seaweeds).
Class 8. CHAROPHYCEAE.	Order Characeae (Stoneworts).

Branch IV. BRYOPHYTA (Bryophytes; Mossworts).

Masses of cells, forming a flat, branching plant with rhizoids, or a leafy stem (oöphyte), reproducing by the union of two protoplasts and the formation of a leafless, spore-bearing stem (sporophyte).

Class 9. HEPATICAE. (Liverworts.)	Order Marchantiaceae (Liverworts, proper). Order Jungermanniaceae (Scale-mosses). Order Anthocerotaceae (Horned Liverworts).
Class 10 MUSCI. (Mosses.)	Order Andreaeaceae. Order Sphagnaceæ (Peat Mosses). Order Archidiaceae. Order Bryaceae (True Mosses).

Branch V. PTERIDOPHYTA (Pteridophytes; Fernworts).

Masses of cells, forming a flat plant, usually with rhizoids (oöphyte), reproducing by the union of two protoplasts and the formation of a stem with roots and spore-bearing leaves (sporophyte).

Class 11. FILICINAE. (Ferns.)	Order Ophioglossaceae (Adder-Tongues). Order Marattiaceae (Ringless Ferns). Order Filices (True Ferns). Order Hydropterideae (Pepperworts).
Class 12. EQUISETINEA.	Order Equisetaceae (Joint-rushes; Horsetails).
Class 13. LYCOPODINAE. (Lycopods.)	Order Lycopodiaceae (Club-mosses). Order Selaginelleae (Little Club-mosses). Order Isoetaceae (Quillworts).

Branch VI. ANTHOPHYTA (Anthophytes; Flowering Plants).

Oöphyte small, few-celled, enclosed in the tissue of the sporophyte; reproducing by the union of two protoplasts and the formation of a sporophyte consisting of a stem with roots and spore-bearing leaves, the latter constituting the "flower."

Class 14. GYMNOSPERMAE. (Gymnosperms.)		Order Cycadeae (Cycads). Order Coniferae (Conifers). Order Gnetaceae (Joint-Firs).
Class 15. ANGIOSPERMAE. (Angiosperms.)	Sub-Cl. I. *Monocotyledones.* (Monocotyledons.)	Order Apocarpae (Water Plantains). Order Coronarieae (Lilies). Order Nudiflorae (Aroids). Order Calycinae (Palms). Order Glumaceae (Grasses and Sedges) Order Hydrales (Waterworts). Order Epigynae (Irids). Order Microspermae (Orchids).
	Sub-Cl. II. *Dictyledones.* (Dicotyledons.) i. Choripetalae.	Order Thalamiflorae (Toral Choripetalae; Torals). Order Disciflorae (Discal Choripetalae; Discals). Order Calyciflorae (Calycal Choripetalae; Calycals).
	ii. Gamopetalae.	Order Heteromerae (Heteromeral Gamopetalae; Heteromerals). Order Bicarpellatae (Bicarpal Gamopetalae; Bicarpals). Order Inferae (Inferal Gamopetalae; Inferals).

In the foregoing, the slime moulds (*Mycetozoa*) have been omitted, as there can be but little doubt that they more properly belong to the animal kingdom.—CHARLES E. BESSEY.

ZOOLOGY.

Pteropodus Dallii sp. nov. Type:—One specimen 200 mm. long, San Francisco. Head 3, depth 3. D, XIII, 14½; A, III, 6½.

Dorsal spines moderate, two in head; lower jaw projecting. Three straight, dark crossbands, one from nape across base of pectoral, one from between 6th and 7th dorsal spine toward anus, a half one from 8th to 10th dorsal spine to lateral line, a broader one below soft dorsal. These bars extending onto the dorsal fin. A few small dark spots on base of pectorals and on shoulder; sides of tail more or less mottled. Dark streaks radiating from eye. Maxillary extending beyond eye, about 2⅓ in head. Eye equals snout, $3\frac{6}{7}$ in head, considerably more than inter-orbital width. Inter-orbital concave, two strong ridges dividing it into a median and two lateral grooves. Pre-orbital narrow, with two flat spine processes. Preopercular spines directed backward. Gill-rakers, about two in orbit. Second anal spine 2⅓ in head. Maxillary, mandibles and snout naked. Scales mostly cycloid. Peritoneum pale. Lower pectoral rays thick and fleshy.

The single specimen belongs to the collections of the Indiana University. We have taken the liberty to name this species for William Healy Dall of the Smithsonian Institution, who has been intimately identified with west coast zoology for many years.

C. H. EIGENMANN & C. H. BEESON.

Changes of Plumage in the Bobolink.—Mr. F. W. Chapman shows in the *Auk*, Nov., 1893, a colored plate illustrating the change of plumage in *Dolichonyx oryzivorus.* According to the author the male bobolink in the course of one year passes through the following phases of plumage. Late in July, when the breeding season is over, the black male undergoes a complete molt and appears in the yellowish plumage of the reed-bird, which closely resembles the plumage of the breeding female. In this costume the birds migrate southward, pausing in the rice fields of our southern states, and apparently continuing their journey to the Campo districts of Brazil. A specimen taken at Corumba, Matto Grosso, Brazil, shows that in the spring, as well as after the breeding season, a complete molt takes place, and the male appears in a suit of black feathers tipped with yellow. As the birds travel southward the yellow tips slowly drop off, the nape, scapula and rump fade, and the bill and feet change respectively from flesh color

to blue black and brownish-black. This is shown in a finely graduated series of intermediates in the American Museum of New York. Birds taken during the summer represent the extreme of faded and abraded plumage.

On Three New Genera of Characinidæ.—The following genera were found by Mr. H. H. Smith in the upper waters of the Jacuhy River in the Brazilian State of Rio Grande do Sul.

ASIPHONICHTHYS. This is Anacyrtus with imperfect lateral line, a few anterior scales only displaying it. The only species is *A. stenopterus* sp. nov., which has the following characters. Scales large, l. l. 42; l. tr. 20. Radii; D 11; A 46; V 9; P 15. Depth 2.66 in length less caudal fin; head in do 3.8. times. Eye 3, equal interorbital space. An obscure postclavicular spot; no basal caudal spot.

CHORIMYCTERUS. This is Characidium with two series of teeth in the lower jaw; the external series, like the premaxillaries, tricuspidate; the posterior series simple. Lateral line complete. *C. tenuis* sp. nov. Scales large, 3—39—2. Radii; D 11; A 9; V 9; P 12. Depth one seventh; head one fifth; eye one third. Silvery, scales with shaded edges.

DIAPOMA. Teeth as in Tetragonopterus. Operculum excavated above and with sub-operculum produced below lateral line and above pectoral fin to an obtuse apex. No gill-rakers on principal limb of first gill arch. Dorsal fin entirely posterior to ventrals. Belly not acute; an adipose fin. Lateral line interrupted. *D. speculiferum* sp. nov. Scales large; 4—37—5. Radii; D. I 9; A. II 29; V 7; P 11. Depth 3.25; head 3.6; eye 3, equal interorbital width. Border of anal concave. Reflection of metallic mercury, especially on the operculum. No spots.—E. D. COPE.

Descriptions of Three New Rodents from California and Oregon.

1. NEOTOMA MONOCHROURA. Sp. nov.

(Type, No. 1739, Ad. ♂, Col. Academy Natural Sciences, Phila., Grant's Pass, Josephine Co., Oregon; col. by Geo. Kenzer.)

Description.—Size large, tail long, unicolor, exceeding length of head and body. Above, dark brownish gray, darkest medially, brownest on sides from nose to root of tail; tail uniform blackish brown, thickly and equally clothed above and below with rather short coarse hairs; color of tail never (?) appreciably lighter below than above as often seen in *N. fuscipes;* chin, throat, inside of fore-legs to toes,

inside of hams, belly, vent and feet uniform yellowish white to the bases of hairs; line of demarcation between colors of upper and lower parts well defined; hinder soles, heel and lower outer part of hind leg dusky; ears large, minutely and scantily haired on both sides; whiskers black and nearly twice as long as head.

Measurements (from well stuffed skin).—Total length 460; tail vertebra 216; hind foot 43; ear, from crown 25. Skull, (occipital and pterygoid region missing).—Length from tip of nasals to posterior end of interparietal 50; base of incisor to post-palatal notch 24; greatest anterior width of pterygoid fossa 2.5; distance from post-palatal notch to posterior notch of incisive foramina 10.4; alveolar length of upper molar series 9; greatest zygomatic breadth 27.5; interorbital constriction 6; length of nasals 20; length of mandible, (condyle to anterior point of ramus), 30; width of mandible, (tip of coronoid process to angle), 15.6.

The closest ally of *monochroura* is *fuscipes*, from which it is distinguished by its larger size, pure yellowish white feet and underparts, its longer unicolor tail and dark brown upper parts.

Its cranial differences from *fuscipes* are well marked for the genus They consist in the greater size, greater relative breadth, flat, less convex contour of cranium viewed laterally, greater relative width of molars and the relative narrowness of the pterygoid fossa.

In *monochroura* the ratio of inter-parietal length to breadth is as six to fourteen, in *fuscipes* it is as six to ten; in the former the length of the palatal region from post-palatal notch to incisive foramina is 11 mm., in the latter it averages about 8 mm. In *fuscipes* the post-palatal notch reaches beyond the middle of the last upper molar and the incisive foramina reach back opposite crowns of first upper molars; in *monochroura* the post-palatal notch is opposite the posterior cusp of last molar and the incisive foramina do not reach to the ante-basal line of the upper premolars by 1·5 mm.

The chief differences of dentition may be seen in the upper molar. The coronoid process of *fuscipes* is flattened horizontally above and directed backward, in *monochroura* it is more erect and rounded.

Three specimens of this rat were taken by Mr. Kenzer, who says they often build a very large and conspicuous nest in the sparsely wooded foothills of the Rogue River and Siskyou Mountains. When driven from these nests they betake themselves to the nearest trees with the agility of a squirrel. *N. cinerea occidentalis* was not found in the same region.

2. NEOTOMA INTERMEDIA. Sp. nov.

(Type, No. 1343 ad. ♂ Col. S. N. Rhoads, Dulzura, San Diego Co., Cal., Aug. 21, 1893, Col. by C. H. Marsh).

Description.—Size small, tail slender, short and distinctly bicolor, ears large. Upper-parts light brownish-gray lined with black, not darker medially; chin, middle of breast, vent, inside of hind legs, lower two thirds of tail, pes and manus white; rest of under parts, soiled grayish buff, brownest across middle and on sides; bases of hairs darkest; upper third of tail sooty blackish; soles naked, sparsely haired at heel.

Measurements.—Total length 318; tail vertebræ 160; hind foot 35; ear from crown 28; (average measure of 4 adults, length 310; tail 155; foot 34; ear 28). Skull.—Basilar length 33; total length 42; greatest breadth 22; interorbital constriction 5.5; length of nasals 16; interparietal breadth 11.5; length 5.9; length of upper molar series (crown surface), 8; pterygoid fossa to incisive foramina 7.8; length of mandible to upper base of incisor 23.8; height of coronoid process from angle 13.5.

This small, bicolor-tailed Wood Rat from southern California has generally been confounded with *N. mexicana*, but is a different animal, being smaller and larger eared. Its cranial differences are decided. Compared with *mexicana* these are, greater relative size of interparietal, bulging of supraoccipital posteriorly beyond the plane of the occipital condyles, and in the extension of the nasal postero-superior processes of the intermaxillary beyond the base of nasals.

In Dr. Merriam's figure[1] and in Baird's description, these processes terminate opposite the base of nasals, barely reaching the anterior plane of the orbits.

The mandible of *intermedius* is much slenderer and the condyle more prolonged posteriorly, the tip of the latter reaching front of the articular surface of the former.

Seven specimens of this species are in the collection, and I am indebted to Mr. G. S. Miller, Jr., for the loan of others. Mr. Oldfield Thomas described[2] a rat, *N. macrotis*, from San Diego, which, so far as the description goes, must be superficially very like *intermedius*, but it is much larger than any in my series, two of which come from the same locality. The skull measurements of *macrotis* are so applicable to those of *fuscipes* as contrasted with those of *intermedius*, and the colors of the feet and tail in *fuscipes* sufficiently variable to make it pos-

---

[1] N. Am. Fauna, No. 3, Pl. X. *N. pinetorum*, Proc. Biol. Soc. Wash., 1893, p. 111.

[2] Am. Mag. N. Hist., Sept. 1893, 234.

sible that *macrotis* is a specimen of *fuscipes* with faintly clouded feet and bicolor tail. These considerations induce me to run the risk of imposing a synonym. Two specimens, one from Banning, another from San Bernardino, Cal., seem to represent a pallid race of *intermedius*, differing from the Dulzura Mountain form in the ashy cast of upper parts and the absence of fulvous on the sides and belly, the hairs of chin, breast and ventral region being white to their bases. The skulls of these light colored specimens show their specific identity with *intermedius*. In the involved state of the case as it now stands, I would refer to this race provisionally as *Neotoma intermedia gilva*.

DIPODOMYS PARVUS. Sp. nov.

(Type, No. 1213 ad. ♀, Col. S. N. Rhoads, San Bernardino, California, June 12, 1892, Col. by R. B. Herron).

Description.—Similar to *D. merriami*, but smaller-bodied, longer-tailed and lacking the black on sides of nose and face. Above, buffy gray, becoming purer buff on sides. Spot at base of ear, fringe over eye, sides of nose, (except base of whiskers), forepart of cheeks, forelegs, inside of hind legs, feet, sides of tail, stripe across thighs and under parts white, strongly defined laterally against color of upper parts. Upper and lower fourth of crested penicillate tail, brownish-black, pencil sooty brown; plantar surface of hind feet brownish; narrow ring around eyes, black.

Measurements.—Total length 248; tail vertebræ 154; hind foot 35; ear (from skin) 10; pencil 25. Skull.—Basilar length 21; mastoid breadth 22.5; interorbital constriction 13; length of nasals 13; crown length of upper molar series 3.6; width of foramen magnum 5; tip of nasals to interparietal 28.4, to extremity of ante-orbital process of maxillary 18.9; greatest ante-orbital width (molar) 20; length of mandible 13.9; height of coronoid process from angle 5.1.

Six specimens represent this species in my collection; three are adult; all were taken in the San Bernardino Valley. The average measurements of adults are somewhat less than those given above. The type is more fulvous than any of the series. Spring specimens are grayer (less fulvous) than type and the tail brush is sooty.

No skull characters or measurements being given for *merriami* by Dr. Mearns, it is impossible to make cranial comparisons with that species.

Compared with *D. similis*[3] and *D. simiolus*[3], *D. parvus* is readily distinguished by its darker, grayer colors. Its skull differs from either of the former in its shortness, greater relative width and size of brain case.

---

[3] Proc. Acad. N. Sci., Phila., Nov., 1893.

In *parvus* the ratio of mastoid breadth to greatest ante-orbital jugal breadth is 88.8, in *simiolus* it is 82.6, in *similis* it is 86.8.

Of the two, *parvus* much more nearly resembles *similis* than *simiolus* in cranial characters and it is possible that a fuller series will show *parvus* to be merely a small, dark subspecies of *similis*.

SAMUEL N. RHOADS.

Zoological News, Vermes.—In a recent paper on the *Ocnerodrilus*, Mr. Gustav Eisen gives a detailed description of the anatomical structure of the 10 known species of this genus. All are tropical or semi-tropical in their habitat, and appear to be restricted to the American Continent. According to the author, the systematic position of this genus is a most interesting one, as showing the affinities with both the water and with the land Oligochœta, and bear a close relationship to Beddard's new genus *Gordiodrilus*.

The paper includes a diagnosis and a synoptic arrangements of the species. (Proceeds. Cal. Acad. Sci., Vol. III).

Mollusca.—A list of the land and marine shells of the Galapagos Islands, compiled by Mr. R. E. C. Stearns, has been published in the Proceeds. U. S. Nat. Mus., Vol. XVI. The list is based on the collection made during the voyage of the Albatross in 1887-88, supplemented by examples contained in the U. S. Nat. Mus. and in other collections from authentic sources. The total number of species is 288, varieties 30, making in all 318, which are segregated as follows. Marine Lamellibranchs 61; Scaphopods 1; Gastropods, marine species 205, with 13 varieties; Gastropods, land species 31, with 17 varieties.

Pisces.—A new shark, *Centrina bruniensis*, from the Tasmanian Coast, and a new species of pelagic fish *Centrolophus maoricus*, from New Zealand, are described by Mr. J. D. Ogilby in the Records of the Australian Museum, Sept., 1893. The latter, according to the author. is quite as interesting a discovery as that of Tetragonurus some years ago at Lord Howe Island, and bears a close analogy to it, both genera being Mediterranean types.

A new Cyprinoid fish, *Couesius greenii* from the headwaters of Frazer River, B. C., is described by Dr. D. S. Jordan. The species is related to *Couesius plumbeus* of the upper Missouri and Lake Superior region, from which species it differs in the larger size of the scales and in some details of form. The head is especially large and heavy. (Proceeds. Nat. Mus., Vol. XVI).

Reptilia.—Mr. Edgar R. Waite has commenced an investigation of the Australian Typhlopidæ. In his first paper upon the subject he describes a new species *T. proximus*, notes thas *T. curtus* Ogilby must be referred to *T. ligatus* Peters, and decides that *T. ruppelli*, which is generally considered identical with *T. vigrescens* Gray, has a distinct specific rank. (Records Austr. Mus., Vol. II, No. 5, 1893).

Mammalia.—An experiment recently conducted by a captain of a vessel, assisted by a naturalist who happened to be on board, shows the traction power of a whale 23 meters long, and weighing about 70 tons, to be close to 145 horse power. However under the conditions in which the experiment was performed it is more than probable that the animal did not exert its full strength. The whale might become of use to the man as a working factor, but it can never be depended upon as is the elephant for example.

Among the mammals recently collected by Dr. W. L. Abbott, in the islands north of Madagascar, are two specimens of an interesting new species of *Pteropus* from Aldabra Island. They are described by Mr. F. W. True in the Proceeds. Nat. Mus., Vol. XVI, under the name *Pteropus aldabrensis.*

New Mammals.—In the fifth volume of the Bulletin of American Mus. Nat. Hist. are from papers dealing with new or little known mammals. Mr. J. A. Allen describes *Didelphys (Micoureus) canescens* from Tehuantepec, *Oryzomys costaricineis* from Costa Rica. Mr. Frank M. Chapman describes *Oryzomys palustris natator* from North Carolina and Florida. In a paper by both gentlemen an account is given of a collection of mammals from Trinidad. 65 species are enumerated as constituting the fauna of the island, of which the following are new:—*Chœronycteris intermedia, Nectomys planipes, Tylomys couesii, Oryzomys speciosus, O. trinitatis, O. velutinus, O. brevicauda, Loncheres castaneus* and *Echimys trinitatis.*

EMBRYOLOGY.[1]

Embryology of Sponges.[2]—Mons. Yves Delage in an interesting paper describes discoveries, the acceptance of which implies the overthrow of our present ideas of sponge morphology. The post-larval development of three silicious sponges, Spongilla, Esperella, Reniera and of a horny sporge, Aplysilla, was followed, and it was found that in the essential features of development all the forms agreed.

Larva.—The larva in all four sponges is a solid larva, the superficial layer of which is composed of slender ciliated cells. The inner one contains, except in Aplysilla, three distinct kinds of cells, each kind destined to form a particular part of the adult body. Just beneath or scattered between the basal parts of the superficial elements, is a discontinuous layer of rounded or irregular cells, which the author claims form the definitive epidermis, and which he, therefore calls epidermic cells. Internal to this layer is a mass composed of amœboid and "intermediary" cells, the former characterized as well by the nucleus as by the power of throwing out pseudopodia, while the latter are immobile cells of rather a negative nature. In the Aplysilla larva the two latter classes cannot be distinguished.

While in Spongilla the ciliated cells form a continuous covering for the larva, in the larvæ of the three other sporges they are absent over one of the poles, posterior in Esperella and Reniera, anterior in Aplysilla. Here the epidermic cells lie at the surface. (Against this interpretation of the cells covering the non-ciliated pole may be urged the observations of the reviewer on Esperella and Tedania, in which sponges it was found that the cells in question and the ciliated cells of the larva are differentiated portions of an external homogenous layer, representing the ectoderm of the embryo.[3])

The large cavity which, as is well known, occupies the anterior portion of the Spongilla larva has, according to the author, no morphological significance. It is only a magnified lacuna, such as is found here

---

[1] Edited by E. A. Andrews Baltimore Md: to whom contributions may be addressed.

[2] Embryogénie des Eponges. Yves Delage. Archives de Zoologie Expérimentale et Génerale. Année, 1892. No. 3.

[3] Notes on the Development of Some Sponges. Journal of Morphology. Vol. V, No. 3, 1891.

and there in the inner mass of all solid sponge larvæ, and disappears during metamorphosis. It is probably concerned in maintaining the equilibrium of the larva.

Metamorphosis.—It is commonly believed that the ciliated cells of the larva flatten and become the epidermis of the adult, but Delage finds that the former absorb their cilia, assume a rounded shape and migrate into the interior, their place being taken by the epidermic cells which fuse with one another so as to form a complete membrane. Only over the non-ciliated pole of the larva does this inter-change of cells fail to take place, for here the epidermic cells have all along been at the surface.

The ciliated cells that migrate into the interior are destined to become the collared cells of the flagellated chambers. The interval between their immigration and the formation of the chambers is marked by a curious association of these cells with the amœboids. The latter elements engulf, amœba-fashion, the former. Complete fusion takes place between the bodies of the amœboid and the absorbed cells, but the nuclei of the latter remain distinct, and range themselves round the larger nucleus of the amœboid. (Multinucleate cells, whether formed in this way or not, undoubtedly exist in the developing sponge. They were observed by Götte (1888) who regarded the smaller bodies contained in them and arranged round the larger central one, as deuto-plastic structures, which become nuclei. Moss (1890) regards the small peripheral bodies simply as deutoplastic structures. Wilson (1891) describes them as nuclei). In Spongilla all the ciliated are so absorbed. In the other sponges only a portion are so absorbed. The rest unite with one another and with the (now) multinucleate amœboids to form a syncitium. To form a flagellated chamber several multinucleate masses approach one another so as to surround a central space, the cavity of the future chamber. The nuclei of the absorbed (ciliated) cells arrange themselves round this cavity and cell bodies are differentiated about them, while the nucleus of the original amœboid cell, surrounded by protoplasm, escapes from the anlage of the chamber, and becomes one of the wandering cells of the adult mesoderm (the reviewer, l. c., has shown that chambers are sometimes formed by the fusion of multinucleate masses, but has also shown that chambers may be simultaneously formed by aggregations of amœboid or "formative" cells, which may or may not be multinucleate. The two processes are regarded as fundamentally the same. Such observations would seem to contradict the author's thesis that it is the immigrated ciliated cells which form the

chambers). The remaining ciliated cells forming the syncytium, unite in a similar manner and build up flagellated chambers.

The chambers are thus formed independently of any central space. The canals are likewise formed independently of each other, as so many irregular spaces, which gradually become lined with an epithelium consisting of "intermediary" cells, the remaining "intermediary" cells becoming the stationary elements of the adult mesoderm. The union into a connected system, of chambers and canals, with the formation of pores and oscula complete the development.

The conclusions enunciated in this paper as to the origin of the canal epithelium and the collared cells of the chambers differ from those presented in the author's previous notes on sponge embryology (Comptes Rendus, 1890, 1891), though the account of the formation of the adult epidermis remains the same. On these points the paper is nearly in harmony with the recent contribution of Maas on the metamorphosis of Esperia (1892), though Maas derives both canal epithelium and collared cells from immigrated ciliated cells. The weight attaching to this harmony of observation on the development of Esperella, is however, lessened by the direct contradiction in the accounts, given by these two authors, of the Spongilla development. In the latter sponge, which according to Delage agrees with Esperella, Maas (1890) has described and figured in a most detailed way the transformation of the larval ciliated cells into the flattened definitive epidermis.

Germs Layers.—As the author points out, his discoveries make it extremely difficult to draw a comparison between the germ layers of the sponges and those of other Metazoa. The case of Sycandra he thinks already constituted a serious difficulty. In this he adopts the point of view of Balfour, and is accordingly perplexed to find granular cells, such as in other larvæ constitute the entoderm, here forming the adult epidermis, while the ciliated cells invaginate to form the epithelium of the paragastric cavity. But the difficulty reaches its height when he attempts to compare the larva of Spongilla with that of other animals. This larva is covered on the outside by cells, which eventually form the epithelium of the flagellated chambers. While the cells which will constitute the adult epidermis are in the larva situated in the interior, i. e. beneath the surface layer of ciliated cells. These facts place us in a dilemma. Accepting the ordinary views on the structure of the sponge body, we would call the epidermis of the adult, ectoderm, and the epithelium of the flagellated chambers, entoderm. Adopting this position, we reach on turning to the larva of Spongilla, the strange conclusion that the swimming larva is covered with a layer of entoderm,

while the ectoderm is internal! If, discouraged at this result, we decide to regard the germ layers as occupying the same relative position in the Spongilla larva as in the larvæ of other Metozoa, and therefore call the superficial layer of ciliated cells ectoderm, and the inner mass of cells entoderm, we reach the equally strange conclusion that the adult epidermis is composed of entoderm, while the lining epithelium of the flagellated chambers is formed of ectoderm! The only way out of the dilemma is to regard the sponges as a phylum which has followed from the start a path of development distinct from that of Cœlenterates and other Metazoa. This being so, a comparison of layers is impossible.

H. V. WILSON.

Development of the Newt.—Edwin Oakes Jordan[3] presented for the Ph. D. degree at Clark University a study of the common newt *Diemyctylus viridescens* Raf., that contains a very clear account of the maturation of the ovum, fertilization, cleavage, and formation and fate of the blastopore in addition to many new facts in the breeding habits of this interesting amphibian.

The " yolk nuclei " are considered at some length and regarded as " having a real physiological significance, probably related to the construction of yolk." In this formation of yolk there is " nothing to indicate that the yolk spherules increase by division, everything on the contrary indicates that they arise from points of independant origin."

The nucleoli in the egg nucleus are described in their formation and disintegration and the idea advanced that they may be but enlargments of the minute granules making up the chromatin threads. Regarding the nucleoli as of nutritive function, acting during the anabolic period of maturation, the author would suggest that they might be compared with the macronucleus of an infusorian.

In the formation of the polar bodies there is an accumulation of pigment at the pole of the spindle suggesting the presence of a centrosome, but none could be found. Much in the same way the entering sperm, in fertilization seems to exhibit an attractive influence over the pigment granules. Elsewhere, however in speaking of the gastrula, the author supposes that pigmentation of the cells is a mark of physiological activity; so that we are left in doubt as to how for an apparent attraction of pigment may be a new formation of it.

In the account of the process of fertilzation we learn that there is no fixed and predetermined point of entrance of sperm and moreover several may, in fact normally do, enter one ovum without in any way causing abnormal development.

---

[3] Journal of Morphology. VIII. 1893.

The reader of this chapter will notice how easy it is to extend ones anthropomorphism even to unclei!

The noticeable fact brought out in studying the cleavage is that it is very irregular and variable in normal eggs. Even the third plane that we expect to find horizontal may be so only in a small part of its extent or, more often, quite vertical. These points will be considered in another paper by the author and Mr. Ecleshymer.

The long axis of the animal is found to develope at right angles to the first cleavage plane: not agreeing with what seems the rule in the frog. This first plane cuts the egg at right angles to its elongation, (it is elongated by pressure in the oviduct) and this invariable rule is, the author holds, the result of that pressure, the first spindle being able to place itself more readily in the one direction than in any other. He thus adopts, provisionally, a mechanical explanation of the determination of the first cleavage plane in the newts' eggs.

In the vexed subject of gastrulation the author's position is that invagination, to some extent, does actually occur. Epiboly can be actually seen in living eggs "the small cells roll down over the others (epibolic invagination), and at the same time the cells around the edge of the blastoderm turn in and dissappear from view (embolic invagination?)"

The blastoderm closes in first from all sides equally then, usually, more rapidly and equally from the right and left side, but sometimes from behind forward more rapidly, occasionally, perhaps, from before backword more rapidly.

A slit is thus formed, which at first opens into the archenteron along its whole length but soon closes, except its anterior end, the evanescent neuropore, and its posterior end the definitive anus.

The author restricts the term primitive streak to the liner fusion of the germ layers.

The conspicuous ectodermal furrow, "neural groove," is thus no part of the primitive streak: it may be merely a result of mechanical stresses.

The mesoblast is figured as presenting, in some cases, most marked lateral pouches at the anterior end of the embryo.

Amphioxus.—Prof. E. B. Wilson[4] has published a fully illustrated account of the most important experimental work upon the eggs of Amphioxus mentioned in the January NATURALIST.

Animal eggs show three chief types of cleavage the radial, the

---

[4] Journal of Morphology. VIII. August 1893.

spiral and the bilateral. In Amphioxus individual eggs are found that conform to each of these types; other intermediate methods are also observed. All these normal modes of clecvage are figured and described with great clearness.

Any attempt to draw a close comparison between the cleavage of Amphioxus and that of the Annelids must fail. The tempting pole cells that the text books have inherited from Hatschek's account cannot be found: " the pole cells of Amphioxus are a myth."

By the method of Driesch the cleavage cells may be isolated and the subsequent cleavage of these studied. Many important facts result of which but a few may be referred to here.

One of the first two cells, completely isolated, may cleave like an egg, form a blastula, gastrula and even larva of the one gill-slit stage, all perfect but of half the normal size. If the cell is not completely isolated from its fellow but merely displaced it will develope more or less separate from its fellow so that all sorts of twins or more or less completely doubled, embryos, blastulas, gastrulas and larvæ result. Here it is of great import to note that the first cleavage of the displaced cells determines the axial relations of the resulting double monsters. " *Even a slight displacement of blastomers in the two-celled stage causes a change in the form of cleavage, such that the blastomers of the half embryo cannot be identified individually with those of a normal embryo half. The normal embryo develops as a unit; if it be disturbed in the two celled stage, this unity is destroyed and two new units established.*"

Moreover it would seem that " the unity of the normal embryo is not caused by a mere juxtoposition of the cells," . . . . " this unity is not mechanical but physiological" . . . . " there must be a structural continuity from cell to cell that is the medium of coordination and that is broken by mechanical displacements of blastmeres."

Returning again to the actual observations. One of the first four cells when isolated may cleave like a whole egg, may form a perfect blastula, gastrula, larva of one fourth the normal size. If the cells of the four-cell stage are not completely isolated various double, triple and quadruple blastulas may arise.

The isolated cell of the eight-cell stage may cleave in a way much like a whole egg but not identical with it. Rarely a blastula may result, one of one eight the normal size.

The author then applies all these observations to the questions of regeneration and the Mosaic Theory of Development. He takes a somewhat middle or combination position between the views of Driesch

and Hertwig on the one hand and of Roux and Weismann on the other.

Roux and Weismann hold that histological differentiation is due to *qualitative* divisions of the idioplasm in successive mitotic cell cleavages and that the embryo is thus a mosaic of self-determining cells: moreover they assume that each cell may also receive *quantitatively* some unmodified idioplasm that remains dormant till called into activity by injury, etc., when regeneration of lost parts is to be accomplished. All this Wilson rejects: retaining, however, a modified form of the mosaic theory, believing that this principal does come in after the earlier stages of cleavage and at very different periods in different animals (the differentiation is however a physiclogical one, there being no loss of nor unequal distribution of actual idioplosm in cell divisions).

That the ontogeny is determined by the character of the ovum at the first; these first phenomena determine the subsequent ones; the prospective value of a cell is a function of its position at first but in later stages becomes fixed by internal changes largely due to the action of the whole upon this cell, these are conceptions in which Wilson comes into closer agreement with Driesch and Hertwig.

Experimental Studies on Teleost Eggs.—Dr. T. H Morgan[5] claims some very important and valuable results from an application of the experimental method to the study of early stages in the embryology of the fish, Ctenolabrus, Serranus and Fundulus.

Awaiting the publication of an illustrated paper we can here note but a few of the chief facts presented in this preliminary communication.

If one of the first blastomeres is removed and destroyed the other may develope a normal embryo which is larger than half a normal embryo but not as large as an entire one.

If half or two-thirds of the yolk be removed from the egg the cleavage is modified and the blastoderm has a peculiar shape yet a normal embryo results.

When the blastodisc is compressed so that a flat plate of cells is formed by cleavage there yet results a normal embryo.

If the germ ring be cut upon one side the embryo continues to be formed and is normal. It can also be shown by markimg the membrane with carmine that the head is a fixed point, the elongation of the body being posterier to this. Hence it follows that the germ ring takes no important part in the formation of the embryo and the *concrescence* theory receives a very severe blow.

[5] Anatomischer Anzeiger. VIII. 1893.

Formation of the Annelid Eye.—Our knowledge of the embryonic stages of the eyes of Annelids has been so scanty that the additions made by Ed. Beraneck[6] cannot be but welcome however little claim they may have to being exhaustive.

The author has studied the egg of the Alciopidæ, in the larva and adult and added to what had been previously made known by Kleinenberg and Greef. The eyes in this family of annelids, it will be remembered, rank amongst the most complex and perfect of visual organs and are far larger and more specialized than those of any other annelids. The structure is as follows; the optic vesicle is closed, a single layer of cells acting as cornea on the side next the thin epidermis and as retina elsewhere. Within the vesicle are the dioptric media: a spherical lens next the cornea, a very voluminous vitreus body filling up the large vesicle and subdivided into an outer part towards the retina and a major mass towards the lens, finally the rods that tip the retinal cells and line the vesicle except on the side of the cornea. It is important to note that the eye is a closed vesicle not a cup as has been claimed by Graber and denied by Graff and Carrière. Moreover this vesicle is a single layer of cells, hence the retina is a single layer of cells, each having a long rod pointing towards the centre of the eye. In the adult there are no cells in the eye except those that form the walls of the vesicle: neither lens nor vitreous body presents any signs of cellular origin. The piginet of the retina is in the cells that bear the rods, at the end whence springs the rod.

It is thus obvious that this eye has no resemblance to the arthropod eye: as the author points out in detail.

The formation of the eye is made out from sections of larvæ. The earliest taken, 3 mm. long, living it will be remembered inside a Ctenophore, has already two large masses of cells separate from the ectoderm and crowded on either side of the few brain cells. These masses are the eyes as first observed. Each is a solid mass with numerous nuclei. Of these nuclei the author would distinguish three kinds—the small ones that form the future vesicle: a few large ones that form certain remarkable gland cells, and finally a single cell in each mass destined to form the beginning of the lens.

In a remarkable way this cell by degeneration forms a centre about which products formed by gland cells aggregate till a minute lens is seen surrounded by more liquid substance: the space so hollowed out in the eye is still surrouned by numerous cells that gradually specialize as the cornea and retina.

[6] Revue Suisse de Zoolögie. I. June 1893.

Very early some of these retinal cells form a rod at the free end and afterward isolated grains of pigment appear in these cells, near the rod end. Meantime the few large gland cells, in the retina, instead of forming rods form a secretion poured out between the lens and the retina. The lens grows enormously, has no longer any trace of its cell origin, and is believed to increase, in some way, by aid of the glandular secretion.

The remarkable gland cells that are mentioned above as occuring even in the youngest larva studied may be found in the adult. They have the important function of secreting the vitreous body.

Each eye has one of these peculiar glands (they are not to be compared with minute gland cells seen in the retina) lying outside the wall of the retina though in its origin one of the mass of cells that gave rise to the whole eye.

This gland is a large protoplasmic mass with two large nuclei and often numerous smaller nuclei and leads through the retina into the optic vesicle by a sort of duct or process.

One other point the author has elucidated is the so called ciliary body, which proves to be merely a part of the retina that developes in an isolated position at the edge of the cornea.

It is apparent that as this eye arises quite independently of the brain and, as far as the authors observations go, of the epidermis also little comfort is to be got from it for those who would reduce the Annelid eye to a simple epidermal thickening: they must fall back upon the statement that the ontogeny of this highly specialized eye in an apparently aberant group throws no light upon the phylogeny of the Annelid eye.

ENTOMOLOGY.[1]

Evolution and Taxonomy.—Under this general title Professor J. H. Comstock has published an extremely important and suggestive essay.[2] Starting with the evident proposition that the systematists of to-day are not making as much use of the theory of descent in taxonomic work as they might, the author suggests that "the logical way to go to work to determine the affinities of the members of a group of organisms is first to endeavor to ascertain the structure of the primitive members of this group; and then endeavor to learn in what ways these primitive forms have been modified by natural selection, keeping in mind that in each generation those forms have survived whose parts were best fitted to perform their functions." Some of the difficulties to be encountered in the carrying out of this suggestion are next considered. "As the structure of a highly organized animal or plant is too complicated to be understood in detail at once, it is suggested that the student begin with the study of a single organ possessed by the members of the group to be classified." He is to observe the forms and functions of this organ; and to determine its primitive form and the various ways in which the primitive form has been modified. Then another organ is to be selected and results compared. In this way a provisional classification can be made.

The second part of Professor Comstock's essay considers the evolution of the wings of insects. The method above suggested is here applied to the wings of the Lepidoptera; and is followed by a contribution to the classification of the Lepidoptera which forms the third part of the essay. This classification is a provisional one, but the author confidently expects "that the principal conclusions stated here will be confirmed by a study of other parts of the body; for in Nature's court the testimony of different witnesses, if rightly understood, will agree."

The proposed classification is indicated in the following table:

---

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Evolution and Taxonomy. An essay on the application of the theory of natural selection in the classification of animals and plants. Illustrated by a study of the evolution of the wings of insects and by a contribution to the classification of the *Lepidoptera.*—Reprinted from the Wilder Quarter-Century Book—Comstock Publishing Co. Ithaca, New York.

A. Suborder JUGATÆ.
  B. *The Macrojugatæ* — Family HEPIALIDÆ.
  BB. *The Microjugatæ* — Family MICROPTERYGIDÆ.
AA. Suborder FRENATÆ.
  B. *The Microfrenatæ.*
    C. *The Tineids* — Superfamily TINEINA.
    CC. *The Tortricids* — Superfamily TORTRICINA.
    CCC. *The Pyralids* — Superfamily PYRALIDINA.
  BB. *The Macrofrenatæ.*
    C. *The Frenulum-conservers.*
      D. Moths in which the reduction of the anal area of the hind wings precedes the reduction of the anal area of the fore wings. No N. American species. *Castnia* an example.
      DD. Moths in which the reduction of the anal area of the fore wings precedes the reduction of the anal area of the hind wings.
        E. *The Generalized Frenulum-conservers.*
          F. Moths in which a great reduction of the subcostal cell of the hind wings is taking place.
            G. Moths in which the anal veins of the fore-wings anastomose so as to appear to be branched outwardly.
              Family MEGALOPYGIDÆ.
            GG. Moths in which the anal veins do not anastomose in such a way as to appear branched outwardly.
              Superfamily ZYGÆINA. (in part)
          FF. Moths in which the subcostal cell of the hind wings is not greatly reduced.
            G. Moths in which the anal veins of the fore-wings anastomose so as to appear to be branched outwardly.
              Family Psychidæ.
            GG. Moths in which the anal veins do not anastomose in such a way as to appear branched outwardly.
              H. — Family COSSIDÆ.
              HH. — Family LIMACODIDÆ.
        EE. *The Specialized Frenulum-conservers.*

F. DIOPTIDÆ.

FF. *The Geometro-Bombycids and the Geometridæ.*

Families NOTODONTIDÆ, BREPHIDÆ, GEOMETRIDÆ.

FFF. *The Noctuo-Bombycids and the Noctuids.*

Familes CYMATOPHORIDÆ, NOCTUIDÆ. LIPARIDÆ, AGARISTIDÆ, and ARCTIIDÆ.

FFFF. *Isolated families of specialized frenulum conservers*

Families SESIIDÆ, THYRIDIDÆ, SPHINGIDÆ, and Superfamily ZYGAEINA.

CC. *The Frenulum-losers.*

D. *The Frenulum-losing Moths.*

Superfamily SATURNIINA and families DREPANIDÆ and LASIOCAMPIDÆ.

DD. THE SKIPPERS.—Butterflies in which all of the branches of radius of the fore wings arise from the discal cell. Family HESPERIDÆ

DDD. *The Butterflies.*—Butterflies in which some of the branches of radius coalesce beyond the apex of the discal cell.

Families PAPILIONIDÆ, PIERIDÆ, LYCÆNIDÆ and NYMPHALIDÆ.

The essay is illustrated by an admirable plate engraved on wood from Nature by Mrs. Comstock and a large number of ink drawings by Mr. E. P. Felt.

Habits of Halobates.—Mr. James J. Walker of the British Royal Navy has recently published[3] an account of his observations on the peculiar bugs of the genus Halobates. He has studied them in many seas for several years, finding the habits of the various species much alike. " In tropical latitudes, when a sailing ship is becalmed, or a steamer is stopped for any purpose on a perfectly calm sea, it is not long before little whitish creatures are seen rapidly swimming over the glassy surface with a sinuous motion, and soon half a dozen or more Halobates are in view at once, evidently attracted by the bulky hull of the ship which they will approach frequently within arm's length. Their progress seems to be effected by a sort of skating action of the long, ciliated, intermediate and hind legs. When the ship is anchored in a current or tide way, they keep abreast of her by a series of short rushes of a foot or so against the stream, giving a

[3] Ent. Month. Mag. 2d. ser. v. IV, p. 227.

speed quite sufficient to stem a current of two or three knots per hour. * * * They seem to like the sunshine and were much scarcer when it was overcast. A heavy swell, provided the weather is quite calm, does not prevent their appearance, but with the ripple caused by the slightest breeze they vanish at once. * * * I have kept the Chinese species alive for several days in a vessel of sea water, at first they are very restless, rushing about and occasionally jumping up two or three inches from the surface, but after a few hours they became much quieter. They then rest on the water with the legs widely extended, and the intermediate pair brought forward so as to have the tarsi in advance of the head. On the approach of a pencil or the finger they dive readily, and swim with great facility beneath the surface, the air entangled in the pubescence giving them a beautiful appearance like that of a globule of mercury or polished silver. This supply of air must be essential to the existence of the insects, which I feel sure must pass a large part of their life beneath the surface of the sea, diving into undisturbed water in rough or even moderate weather, and coming up again only when it is absolutely calm."

Mr. Walker is unable to add anything to our knowledge of the feeding habits of these bugs. "The union of the sexes takes place on the surface of the sea, and the eggs are unquestionably carried about by the female attached to the extremity of the abdomen for some time before she parts with them." Two females of *H. Wulderstorffii* were taken from the Marquesas Islands with eggs thus attached. The eggs are large for the insect, cylindrical with rounded ends, and ochraceous yellow. Where they are finally deposited he did not observe though[4] in a subsequent note attention is called to Witlaczil's record of the finding of a bird's feather at sea covered with the eggs of Halobates.

Pupation of Gyrinus and Dineutes.—Mr. H. F. Wickham continues his studies of the early stages of North American Coleoptera, his latest contribution[5] including descriptions of nine species. He describes the larva of *Gyrinus picipes* as pupating in mud cells without any intermixture of silk. "Probably the larva uses any readily accessible matter in the formation of its cell and when under stones would use mud, while if under bark might utilize wood or bark fibre, thus giving the 'cocoon' a papery consistence." The pupation of *Dineutes assimilis* is described thus: "The larvæ on coming out of the water repair to the under surface of a stone or a board close

---

[4] lc. p. 252.

[5] Bull. Lab. Nat. Hist. Univ. of Iowa. II, pp. 330—344, pl. IX.

enough to the waters edge to insure continued dampness, and there construct an oval cell of earth, without any admixture of silk so far as I can find. These cells are not simple excavations of earth beneath the stone but are built upon it like the cells of some of our mudwasps, and are not very unlike them in shape."

Hermann August Hagen.—This veteran entomologist, for many years Professor of entomology at Harvard College, died at his home in Cambridge, Nov 9 last. Born in Königsberg, Prussia, May 30, 1817, he graduated in medicine in 1840, and was a practicing physician in Königsburg until 1867. He then, at the invitation of the elder Agassiz, came to Cambridge to become Curator of the entomological department of the Museum of Comparative Zoology, a position which he retained until his death, though because of ill health he has not been actively at work for several years. Dr. Hagen has long been known as an authority in entomology, especially on the Neuroptera and their allies; and by his work at the Museum has greatly helped the development of the science in America.

Entomological Notes.—Professor L. M. Underwood has edited and the U. S. National Museum has published (Bull. 46) the papers on North American Myriopoda written by the late C. H. Bollman. The Bulletin covers more than 200 pages and must form the basis of future work on this neglected group.

At the meeting of the London Entomological Society, Oct. 4, specimens of Lepidoptera which had been exposed in the pupa stage to low temperatures were exhibited by Mr. F. Merrifield . " *Vanessa polychloros* was much darkened, especially toward the hinder margin, by a low temperature. *Vanessa c-album* showed effects on both sides, especially in the female; they were striking on the under-side. Some *Vanessas* showed the gradual disintegration, by exposure to a low temperature, of the ocellus on the fore wing, which in extreme specimens ceased to be an ocellus."

Various species of Vespa have been so abundant the past season in Great Britian that accounts of the "Plague of Wasps" have been occasionally published. Their unusual abundance is attributed to recent favorable meteorological conditions.

The U. S. National Museum has published in the Proceedings (No. 950) "A Descriptive Catalogue of the Harvest-spiders (Phalangiidæ of Ohio" by Clarence M. Weed. Fifteen species or subspecies are included in the list.

Prof. J. B. Smith describes [6]the new genus Tristyla with one species, and seven other new species of Noctuidæ collected by the Death Valley expedition.

In reporting on a collection of ants from Lower California and Sonora, Mexico, M. Theo Pergande describes[7] two new species of Camponotus and one each of Atta and Aphænogoster, as well as a new variety of *Pogonomyrex badius* Ltr.

Mr. Lawrence Bruner furnishes as his report as Entomologist to the Nebraska State Board of Agriculture a valuable discussion, covering more than one hundred pages, of the Insect Enemies of the Small Grains. The list includes 143 species distributed among the orders thus: Diptera, 24; Hymenoptera, 11; Lepidoptera, 22; Coleoptera, 33; Hemiptera, 28; Thysanoptera, 2; Orthoptera, 18; Thysanura, 3; Acarina, 2.

The peculiar pocket like abdominal appendages of female moths of the family Acræidæ are believed by A. F. Rogenhofer to be used in copulation.[8]

From recent studies of the pupæ of moths Dr. G. A. Chapman concludes[9] that the Pterophoridæ are not closely related to the Pyralidæ or Alucitidæ.

The discussion concerning the "highest" order of insects has been recently continued in *Science* by Packard, Smith and Riley, all of whom favor the placing of the Hymenoptera above the Diptera.

From recent anatomical studies, Krasilstschik concludes[10] that Phylloxera and Chermes should form the family Phylloxeridæ and should be regarded as more primitive than the Aphididæ or Coccidæ.

Dr. C. V. Riley's report as entomologist to the U. S. Department of Agriculture for 1892 discusses recent international exchanges of beneficial insects, the importation of two dangerous insects—the potato tuber worm (*Lita solanella* Boisd.) and the Olive Pollinia (*Pollinia costæ* Targ,)—the spread of the horn fly, the ox bot, the rose sawflies, the strawberry weevil, the elm leaf beetle and experiments with the European white grub fungus. In addition to these discussions there is a brief review of the work of the field agents of the division, and summarized accounts of the pea and bean weevils, the sugar-beet web worm (*Loxostege sticticalis* L.), the sugar-cane pin borer (*Xyleborus perforans* Woll.), and the new insectary of the department.

[6] Insect Life, V, 328—344.

[7] Proc. Cal. Acad. Sci., ser. 2, v. IV, pp. 26—36.

[8] J. R. M. Soc., 1893, p. 322.

[9] Trans. Ent. Soc. London, 1893, p. 97 et seq.

[10] Zoolog. Anzeiger, 1893.

A number of interesting entomological papers have been published by Mr. F. M. Webster in the third issue of the technical series of the Bulletin of the Ohio Experiment Station. Many new species of insects are described by specialists. The publication of these new species in such a bulletin is certainly of questionable propriety, unless they also appear in entomological journals. Such bulletins are of decided value and are useful outlets for much matter that accumulates in pursuance of station work—such as biographies, faunal lists, etc.—and it is desirable that they be confined to this instead of containing isolated descriptions of new species.

ARCHEOLOGY AND ETHNOLOGY.[1]

The "Plateau Implements" of Southern England.—It is natural to suppose, whether we believe in the skeleton of Castenodolo, the scratched bones of Monte Aperto, and the worked flints of Thenay and Otta or not, that man did not of a sudden manufacture "Turtle-backs" of Chellean type, and that somewhere on thé globe stones flaked more rudely than the rudest of these, tell of his childish handiwork.

The question as to the 2500 flint pebbles, nicked, nipped, notched, saw edged, and sharp ended, called "Plateau Implements" and collected by Mr. Benjamin Harrison near Itham in Kent, England, is whether they are or are not artificial.

The gravels from which they come have not been geologically dated by intermixed fossils, but the beds—if not Tertiary must be far older than the drift "turtle-back" bearing strata of the Darent vale below them. They spread for miles along a ridge-top 340 feet above the sea, with no place to wash from and cannot therefore be connected with the present river system of South England.

Where the surface loam has been weathered off them, the yellow patinated "implements" are found lying on the gravel, and it is asserted that the latter are in place and not dropped there like the white chipped celts of Neolithic men that sometimes lie with them.

Careful trenching is needed to demonstrate the true position of these strange stones, duplicates of which Mr. Worthington G. Smith says he has found in the later drift deposits along with "Turtle-backs" near Dunstable, in Bedfordshire. But Professor Prestwich one of the first recognizers of Boucher de Perthes' discovery in 1859, views Mr. Harrisons specimens which now awaken contention, as the handiwork of men living before the time of the drift.

Quaternary Gravel Specimens in Spain.—In October, 1892, the Baron de Baye visiting the Quaternary gravel exposures at San Isidro on the right bank of the Mazanares opposite Madrid, bought from a workman two "Turtle-backs" (if we may here use the inoffensive word) one of quartzite and one of flint, of the type called Chellean by M. Gabriel de Mortillet (more or less leaf shaped and chipped on both sides) also one other specimen of flint of the pattern called Mousterian by de Mortillet (ie, chipped only on one side,)

---

[1] This department is edited by Mr. H. C. Mercer, University of Pennsylvania.

The workman told M. de Baye that he had found the Chellean and Mousterian specimens close together in the same top layer, and the latter repeated the statement before the meeting of the Societé de Anthropologie at Paris on July 15, 1893, reading also a letter from M. Siret the geologist who said he had discovered in the summer of 1892, 30 Chellean, 1 Solutrian (broad thin well worked leaf shaped blade) and 6 Mousterian specimens in the self same upper stratum.

Two Mousterian objects of this list were shown but how many of the 37 were found with M. Sirets' own hands in place does not appear.

If these stone Implement types running through the drift deposits and cave layers of France. (a) Chellean (River Drift), (b) Mousterian (cave period of chipping flakes on one side only) (c) Solutrian (cave period of finest blade chipping) and (d) Magdalenian (cave period of bone implements and animal sketching) represent cultural epochs in Mans' evolution as is claimed by M. de Mortillet, then these Spanish specimens should have been found in separate layers, or at intervals, and not all close together at about 6 to 15 feet from the surface.

M. de Mortillet objected at the meeting that hearsay did not prove the alleged mingling. He said that the two Chellean "Turtle-backs" shown were not typical and believed that if the case were reconsidered a sequence of the types would be found in the different layers at San Isidro, as in France.

It was unfortunate that M. Siret was not there to explain his startling assertion that everything was unclassifiably jumbled together in the upper layer. But to find the Chellean at the top, was what I afterward did when I pulled out a leaf shaped "turtle-back" of flint[2] from the perpendicular bank of the Carreña Sacerdotal at a depth of 1·80 metres from the surface, on Dec. 31, 1892.—H. C. MERCER.

The non-existence of Paleolithic Culture.—Mr. J. D. McGuire in the American Anthropologist for July, 1893, denies the existence of a time when Man chipped but could not polish stone. Assailing not the antiquity of human remains but their cultural significance, and backed by his valuable and unique experience in the carving, polishing and boring processes of the stone age, he attacks Sir John Lubbocks celebrated definition as follows.

(1) Battering and grinding is easier than chipping and so must have preceeded it.

(2) Paleolithic Men made pottery for it is found in the Paleolithic

---

[2] Now in the Archæological Museum of the University of Pennsylvania at Philadelphia.

caves of Spy in Belgium (under Mousterian), Trou Magrite Belgium (with Mammoth and Rhinoceros), Nabrigas, France (with cave Bear), and Engis Belgium (with Rhinoceros).

(3) Paleolithic cave men bored and carved bone, and used pitted stone hammers at Les Eyzies, La Madeleine, Gorge D'Enfer and Laugerie Basse and therefore should have been able to polish stone.

(4) The absence of Drift specimens in Neolithic graves means that Drift "implements" in Europe are like American quarry "Turtle-backs" not implements at all and so not placed by the Neolithic men who made them, with their dead.

(5) Polished stone implements through made by Drift Men are absent from the Drift because the Drift beds were like American quarries where the stone chipper left no village relics.

(6) The Drift Mans' pottery is not in the Drift because even if lost there gravel washing would destroy it.

We follow these arguments with great interest but think (1) that while Indian blade making of the Quarry time was a complex difficult art, chip knife or "Teshoa" making at one blow, or "Turtle-back" making at 20 blows (if "Turtle-back" is all we want) is easier than hand hammering and grinding. (2) The 2nd argument warrants a review of the cave records, for if Paleolithic cave men did make pottery then the French classification collapses, and the Museums and Handbooks of Europe which it seems have failed to bring out the fact, are not to be trusted. (3) Why men who bored polished and carved bone, sketched realistic animal designs, and chipped blades equal in make to Mexican sacrificial knives did not polish stone seems incomprehensible. But the European Museums clearly assert that no polished stone tool has been found in the caves. If true, the fact is conclusive against Mr. McGuire. The finding of pitted hammerstones in Paleolithic caves involves a tendency to carving in the indentations themselves, but some of these hammers might have been corn and not stone bruisers after all, just as some such (Brough Smith's Aborigines of Victoria p. 385) were used by Australian native divers for clapping under water to scare fish into nets as well as to pound roots.

As to argument (4), the most striking European Drift form, the blunt based "Coup de Poing" is not like the turtle-backs in the American quarries examined. By no quarry turtle-back analysis can it be called an unfinished implement and so unadapted for deposit in graves.

If Neolithic Men made Coups de Poing as Indians made turtle-backs we should only have to go to a Neolithic Quarry to find them, but Spiennes, fairly considered, contains none.

To argument (5) it may be said that European Drift deposits are really analogous to our Riverside workshops where Indian relics are plenty, and not to quarries; while if we do compare them to quarries Indian relics have been found in my knowledge, at four. Realizing this we see no reason why polished implements should not be found in the Drift if the Drift Men made them. The 6th argument as to the destruction of pottery in washing gravel seems conclusive against expecting to find it there.

Thanks are due to Mr. McGuire for his exceedingly interesting and suggestive paper which should suffice to induce revision of the European Cave classification in which as it suggests there may be serious flaws.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences, Biological Section, Nov. 20. —The following papers were read:—"On the Scope of Modern Physiology," by F. S. Lee; "Notes on recently discovered deposits of Diatomaceous Earths in the Adirondacks," by C. F. Cox; "Systematic Notes on Dracocephalum and Cedronella," by N. L. Britton.

December 4.—Professor H. F. Osborn described and exhibited a series of restorations of lower Miocene mammals including Titanotherium, Aceratherium, Metamynodon, Protapirus, Elotherium, Oreodon and other characteristic forms. This is the first of a series of tertiary mammal groups in preparation.

Mr. O. L. Strong described a new modification of the rapid Golgi method designed to eliminate some of its present defects, i. e., uncertainty of success and irregularity in the stain when attained, due probably in great measure to the feeble penetration of the silver nitrate.

The modification consisted in adding a certain proportion of sodium sulphate to the silver nitrate which the specimens are placed after the hardening in osmic-bichromate.

While this modification has hardly been tried sufficiently to ascertain exactly its merits, it seemed certain that in some cases, at least, it gave much more complete and uniformly stained pictures of the nervous system than the old procedure.

Specimens of the heart of a tadpole and cord of an embryo chick were exhibited.

Professor E. B. Wilson noted a mode of preparation of lobster testis which gave results especially favorable for class work in Cytology.

BASHFORD DEAN, *Rec. Sec.*

Boston Society of Natural History, November 15th, 1893.— The following paper was read: Dr. J. Walter Fewkes, Comparative ceremoniology of the Mexican and Pueblo Indians.

December 6.—The folowing papers were read: Mr. R. E. Dodge, the Geographical Development of River Terraces; Professor W. M. Davis, Facetted Stones from Cape Cod. Both papers were illustrated by stereopticon views.

December 20.—The following papers were read: Mr. Severance Burrage, Observations on insectivorous plant, the thread-leaved Sundew (*Drosera filiformis Raf.*); Merritt Lyndon Fernald, On the geo-

graphical distribution of the flowering plants of the upper St. John River, northern Maine.

SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington.—Following was the programme of the evening. Symposium:—B. E. Fernow, C. W. Stiles, Theo. N. Gill, Geo. Marx and others; on what are the especial needs of the Biological Society of Washington.

December 2, 1893.—The following communications were read: Mr. Frederick H. Blodgett, Notes on the Development of the Bulb of the Adder's Tongue: Mr. E. W. Nelson, A New Species of Lagomys from Alaska; Dr. Erwin F. Smith, On a Bacterial Disease of Cucumbers, etc., working through the Fibrovascular Bundles; Probably Transmitted by Insects; Dr. C. W. Stiles, The Teaching of Biology in Colleges.

FREDERIC A. LUCAS, *Secretary.*

Odontological Society of Pennsylvania, Saturday, December 9th, 8 P. M.—William Romaine Newbold, Ph. D., of the University of Pennsylvania read a paper: "The Psychological Significance of Hypnotic Suggestion and Kindred Phenomena."

Dr. Thomas Fillebrown of Boston, Mass., opened the discussion. The following is an abstract of Dr. Newbold s paper.

The psychical phenomena of the hypnotic state can for the most part be regarded as due to heightened suggestibility. Suggestibility is found in all normal persons and occurs not infrequently in pathological degree. It can be connected with the conception of the mental state as representing to us cortical processes and hence as a dynamic thing, due to definite causes and necessarily involving definite effects.

Normal perceiving and thinking involves the functioning of the cortex as a whole composed of parts more or less differentiated functionally and standing in multiple intercorrellations with one another. Hence in normal life the effects of any given cortical process or mental state can never be dissociated from those of preëxisting activities and predispositions.

In the condition known as heightened suggestibility, by whatever agency it be produced, the cortical coördination is unimpaired; those activities which chiefly modify the nascent process or state being temporarily inhibited; we can study at leisure the development and results of any artificially produced process, whether connected with consciousness or not.

The kindred phenomena of "the fixed idea," "hysteria," "epilepsy," "double consciousness," etc., are due to analagous disturbances in cortical coördination with sundry local complications.

The relation of consciousness to such states is obscure. In some it undoubtedly exists; in some its existence is questionable.

If the occurrence of telepathic phenomena be admitted, they must be explained rather by the conveyance of suggestion by some means at present unrecognized than as proving the existence of some unknown force in the operator constraining the subject to perform acts against his own will.

ALONZO BOICE, *Secretary.*

SCIENTIFIC NEWS.

The University of Kansas has issued six numbers of the "Kansas University Quarterly." The Natural History articles so far published are as follows:—Kansas Pterodactyls, pts. 1 & 2, by S. W. Williston; Kansas Mosasaurs by S. W. Williston and E. C. Case; Notes and Descriptions of Syrphidæ by W. A. Snow; Notes on *Meliteria dentata* and the Sclerites of the head of *Danais archippus* by V. L. Kellogg; Diptera Braziliana pts. II & III; the Apioceridæ and their allies, and new or little known Diptera by S. W. Williston; The Great Spirit Spring Mound and the Delicacy of the sense of taste among Indians by E. H. S. Bailey; Notes on some Diseases of Grasses by W. C. Stearns; Revision of the genera Dolichopus and Hygroceleuthus and new genera and species of Psilopinæ by J. M. Aldrich. The Quarterly is well gotten out and reflects much credit upon the University.

Professor Hermann A. Hagen died in Cambridge, Mass., Nov. 8th, 1893. He was born in Königsberg, Prussia, May 30, 1817, and received his M. D. from the University there in 1840. Later he studied in Berlin, Vienna, Paris and other European cities. Meanwhile he devoted considerable attention to entomology, and in 1843 published his first paper "Prussian Odonata" This publication gave him considerable reputation. In 1843 he returned to Königsberg, entered on the general practice of medicine, and for three years was first assistant in the Surgical Hospital. From 1863 until 1867 he was Vice-President of the City Council and member of the school board. He became acquainted with Louis Agassiz, who invited Prof. Hagen to leave Germany and come to Cambridge. Prof. Hagen accepted the offer

and became assistant in entomology at the Agassiz Museum. In 1870 he was made Professor at Harvard. Since that time Professor Hagen has kept his connection with the Harvard University, and for years has been one of the most famous men in the University. Professor Hagen's contributions to the science of entomology have been of great value. He received the honorary degree of Ph. D. from the University of Königsberg in 1863, and in 1887 Harvard conferred upon him the honorary degree of S. D. His publications include more than 400 articles, of which the most important was his "Bibliotheca Entomologica," published in Leipzig in 1862.

The stratigraphical collection of Canadian rocks on exhibition at the Columbian Exposition, Chicago, has been catalogued by Mr. W. F. Ferrier. The collection comprises 1500 specimens, and illustrates all the formations known to occur in the Dominion of Canada, from the Laurentian to the Pleistocene. As the collection is very complete, geographically, it is proposed to incorporate it with that already in the Museum of the Canada Geological Survey and thus form an unrivalled series of the rocks of Canada.

Erratum in note of a paper by Mrs. E. G. Britton, on page 826, line 24 from top, the sixth word should be *disproved*.

Albert F. Woods, Assistant in Botany in the University of Nebraska, has been appointed Assistant Pathologist in the Section of Vegetable Pathology of the Department of Agriculture in Washington.

"Briefly describe the heart and its function or work." Ans. "The heart is a comical shaped bag. The heart is divided into several parts by a fleshy petition. These parts are called the right artillery, left artillery and so forth. The function of the heart is between the lungs. The work of the heart is to repair the different organs in about a half minute."

"What are metamorphic rocks?" Ans. "Rocks that contain metaphors."—*London Globe.*

THE
AMERICAN NATURALIST

Vol. XXVIII. February, 1894. 326

SOME RECENT CHEMICO-PHYSIOLOGICAL DISCOVERIES REGARDING THE CELL.[1]

By R. H. Chittenden.

In opening this discussion, or rather in making such remarks as seem appropriate in connection with the subject before us for consideration this morning, I am reminded that the chemistry and the chemical processes of the cell have received very little attention from the generality of biologists. This is perhaps natural, since the morphological side of biology has for many years presented a more attractive field for the majority of scientific workers, and the difficulties have not been so great as in the chemical and physiological problems awaiting solution.

Simplicity of structure, as embodied in the single cell of a unicellular organism, means to the physiologist increased complexity of function. In the higher organism with its many groups of cells, we can easily comprehend how one group may be characterized by one line of functional activity, while a neighboring group of cells in the form of another tissue or organ is endowed with functional activity of quite a different order. One group of cells is set apart for one line of duties, while another group has quite different functions; in other

---

[1] The Introductory paper in a discussion of our present knowledge of the cell at the meeting of the American Society of Naturalists, New Haven, Dec. 28, 1893.

words, structural differentiation has begotten or accompanied chemical and functional differentiation. All this seems quite plausible, indeed, quite natural, but how shall we explain all the varied functions possessed by the unicellular organism unless we accept the idea of a possible chemical differentiation of the cell protoplasm inside the cell wall. Digestion, assimilation, excretion and reproduction are functions possessed alike by the unicellular organism and its higher neighbor the multicellular organism. In the latter, we recognize distinct groups of specially characterized cells for each phase and form of functional activity, each group as in a gland or tissue having a different chemical structure with its own peculiar line of chemical activity and its own particular katabolic products. In the unicellular organism, on the other hand, a differentiation of protoplasmic particles is the only plausible explanation of the diverse functions of the living cell.

This being true we can no longer look on the cell as the ultimate unit of structure, certainly not from the chemical standpoint. The cell may be considered rather as a complex molecule, or series of molecules, built up of many morphological atoms or rather groups of atoms. Thus, the cytoplasm, for example, may be looked upon as a multitude or mass of living units of structure, as the plasomen of Wiesner. Call them what you will—plasomen, idiosomes, gemmules, plastidules, idioblasts or physiological units—these particles have the power of dividing, and, indeed, of growth and assimilation. Moreover, it is possible that this power of growth and reproduction may be independent, in part at least, of the cell nucleus and the constituent karyoplasm. Furthermore, the nucleus too may perhaps be considered as composed of auto-divisible organic individuals, these hypothetical particles, both of the cytoplasm and of the karyoplasm, being considered as the living atoms of the molecule, the last divisible living bodies of the cell.

For fifty years or more, the cell theory of structure and development as outlined by Schleiden and Schwann has been the nucleus for nearly all phases of biological work, and although our knowledge of the cell has advanced greatly in

all directions during the last half-century, yet nearly all the problems of life are still viewed from the standpoint of the cell theory; morphological facts and physiological facts are all tested more or less by their relationship to cell structure and cell function. As Whitman[2] has aptly said "all the searchlights of the biological sciences have been turned upon the cell; it has been hunted up and down through every grade of organization; it has been searched inside and out, experimented upon, and studied in its manifold relations as a unit of form and function", and yet, if I understand the matter aright, many morphologists to-day are inclined to protest somewhat against "the complete ascendency of the cell as a unit of organization." We must not ignore the existence of the organic chemical compounds, with their peculiar molecular structure, which compose the cell protoplasm; the whole secret of organization, assimilation, growth, development, etc., may rest upon these ultimate elements of living matter. These may be the actual representatives of the physiological units of Herbert Spencer, or the plasomes of Wiesner; they may be the real units of all forms of living matter, the bearers of heredity and the true builders of the organism whether it be simple or complex. These protoplasmic particles are not necessarily limited in their action, or in the influence they exert, by cell walls or other boundaries.

The physiologist, however, like all other biologists, has been wont to look upon the cell as "the unit of the manifold variable forms of the organism" (Hammarsten), representing the seat of the many varied chemical processes characteristic of the individual tissues and organs. The cells naturally, through their variable activity, govern the range and intensity of the metabolic processes of the organism; but all this is simply a general expression of the idea that the chemical processes of the higher organism are localized in the cellular tissues of the body rather than in the adjacent fluids. It appears to me that we have every reason to believe in the existence of ultimate particles of living matter, both cytoplasm and karyoplasm, in-

[2] The inadequacy of the cell-theory of development. Journal of Morphology, Vol. 8, p. 639.

side the cell, which are the real units of the organism. They may not be recognizable morphologically, but they exist nevertheless as individual links in that chain of molecules of which we believe living protoplasm to be composed. As Quincke[3] has recently said " bioiogical science must, well or ill, take into account the fact that the development of the cell and the life of organic nature depends on masses and layers which cannot be seen by the microscope alone." Hence, the chemistry of the cell offers an interesting field of work full of promise, although for the most part it has been studied mainly with a view to obtaining more light regarding the general metabolic processes of the higher organisms.

From a chemical standpoint, the living animal cell may be considered as a combination of varied chemical substances always in a state of unequilibrium, unstable in the highest degree, readily prone to break down by oxidation or cleavage into bodies of less complexity, each downward step in the process of disintegration, giving rise to the liberation of a certain amount of energy. These explosive, or it may be gradual, decompositions are going on continually as long as life endures, and chemical transformations and chemical decompositions are therefore an essential part of the life history of the cell, or of the organism of which it is an integral part. In them are hidden many of life's mysteries, and some of the most intricate as well as important phases of physiological phenomena are closely connected with these more or less obscure chemical transformations.

This constant liberation of energy, so characteristic of the living animal cell, coming as it does from the continued disintegration of the living substance of the organism creates a demand for fresh material to supply the place of that which has undergone this vital decay, otherwise the vital energies flag and the bodily structure withers away. The food material supplied to meet this demand, although it may be easily oxidizable or combustible cannot supply the needs of the organism without becoming vitalized. As dead, inert matter it is simply combustible; it can exhibit energy as heat only like

---

[3] Nature. Vol. 49. p. 6.

other forms of organic matter, but its energy cannot be made available in the manner required by the living animal organism. It must first be fitted for assimilation through digestion or otherwise; after which, having passed into the circulating fluids, it finally reaches the cell under whose influence it undergoes a final change by which it is raised to a higher plane. That which was dead has become alive, a chemical transformation has occurred, the atoms in the molecule have been rearranged and we have to deal with living matter; a change accomplished through the anabolic power of the living cell, or better of the cell protoplasm. Anabolism and katabolism, construction and destruction, are thus going on continually in the living animal cell side by side as a necessary concomitant of life, but the processes are not everywhere of the same order. They are qualitatively and quantitatively unlike, especially the katabolic, the latter showing some peculiarities characteristic of almost every individual group of cells as comprised in individual organs or tissues. Each individual cell as a component of the many and varied tissues of the organism is to be compared to a well equipped chemical laboratory, the character and amount of the work produced being dependent in part upon the intrinsic qualities of the cell, *i. e.* of the cell protoplasm, and in part upon the nature of its surroundings or environment. While these statements apply more particularly to the animal cell, they are likewise true of the vegetable cell, the only difference being that in the latter we find a predominance of synthetical processes, a remarkable power of building up complex substances such as starch and proteid out of the simple food material obtained from the air and the soil, while the animal cell is especially characterized by the extent of its katabolic processes.

It is thus very evident that while in the early stages of growth and development, all animal cells, for example, may show a striking similarity in composition, as soon as differentiation in form begins to manifest itself with an accompaniment of functional activity, chemical composition is gradually altered until at last each group of cells characteristic of the individual organs and tissues acquires a composition peculiar

to itself. Obviously, however, the most striking differences are manifested in the character of the so-called secondary constituents of the cell protoplasm, *i. e.* the katabolic products of the cell's activity, such as the different enzymes or their antecedents, the albuminoids, pigments, fat, glycogen, etc., to which must be added the substratum of dead food material for the nutrition of the cell. From this very diversity in the character of the katabolic products of protoplasmic activity, we might easily argue corresponding differences in the character of the primary constituents of the cell protoplasm, which in turn would imply fundamental differences in the nature of the anabolic processes by which the cell protoplasm is formed.

It will be seen from what has just been said that it is not an easy matter to discriminate between the primary constituents of a cell and the so-called secondary constituents, or such as arise from the katabolic activity of the primary bodies. Furthermore, it is an extremely difficult matter to isolate from a given tissue or organ the active cells entering into its structure, or to collect together a sufficient number of unicellular organisms free from impurities or admixtures. When, however, this has been accomplished and we are ready to analyze the isolated cells, we are at once confronted with the limitations attending this kind of work, especially the fact that any ordinary method of separation or analysis, even the initiatory steps in the process, immediately transforms the living matter into dead matter, which transformation may be accompanied by cleavage or other chemical changes of more or less complexity; so that the bodies we identify as components of the cell protoplasm may be simply alteration products, or fragments of the larger and more complex molecules resident in the living matter.

From microscopical examination we have evidence that protoplasm is far from being homogeneous, that it is loaded with granules and pervaded by a mesh-work of irregular arrangement. These various forms of protoplasmic differentiation have, as you know, been variously named by different investigators, as the spongioplasm, paraplasm, hyaloplasm, etc.,

and we are led to infer marked differences in chemical composition from the behavior of the several parts of the cell toward the many pigments or dyes used in histological investigation. There can be no manner of doubt that the differences in color between the nucleus and the cytoplasm of the cell, for example, as brought out by the agency of various pigments is due to differences in chemical composition. Again, as you are well aware, Ehrlich has been able to discriminate between the different varieties of granules found in cell protoplasm by their behavior toward neutral, acid and alkaline aniline dyes. Thus, in the centresome we have a mass of differentiated cytoplasm, which as Watasé[4] has shown in the egg of Unio, may be made to stand out with great distinctness by means of acid-fuchsin, while the spindle fibres and the rays of the aster remain practically unstained, thus clearly pointing to differences in chemical composition which are well worthy of note. Again, there are still other granules frequently present in the cytoplasm of many cells, staining dark with osmic acid, which indicate still other differences in chemical composition. But our knowledge concerning the chemical nature of protoplasm is far too imperfect and scanty to admit of our drawing any other than the broadest generalizations from the affinity the protoplasm may show for various pigments.

Further, as you well know, the nuclear constituents have been divided by various investigators, as by Flemming, into several groups according to the action of different stains; thus, we have the chromatic substance or chromatin, which stains readily with the aniline dyes and which comprises especially the nuclear network, then achromatin, or that portion of the nucleus which does not stain readily, as the nuclear matrix and the nuclear membrane.

Such statements as these may be added to almost indefinitely, but for our purpose the above are amply sufficient to indicate the existence of marked chemical differences in the cell cytoplasm and karyoplasm. And, indeed, that is all they do indicate; they give us very little knowledge of the real nature of the substances which are the cause of these differ-

---

[4] Homology of the Centresome. Journal of Morphology, Vol. 8, p. 433.

ences in reaction. We must have more definite chemical knowledge before we can hope to attain to a clearer understanding of the actual make up of cell protoplasm. Further, such knowledge is not to be obtained solely by micro-chemical study. The latter is surely important, but macroscopical methods must be relied upon mainly to furnish the desired information, and when we have full knowledge of the chemical nature of the substances present in the protoplasm, we may hope to find micro-chemical methods adapted to their accurate detection.

What now is the state of our knowledge regarding the primary constituents of cell protoplasm? Taking the results which have been elaborated by painstaking work during the last ten years, I think we are justified in asserting that the primary constituents of the cytoplasm are especially a peculiar group of proteid or albuminous bodies known as nucleo-albumins and characterized by containing phosphorus. These are by far the most numerous of the substances present in the cytoplasm. Next in importance are simple proteids belonging mainly to the group of globulins, a class of albuminous bodies insoluble in water but readily dissolved by 5–10 per cent. salt solution. Lecithin comes next, a complex phosphorized body having a constitution similar to that of a fat and yielding by decomposition higher fatty acids, glycero-phosphoric acid and cholin. This body is also insoluble in water and likewise in salt solution, but is readily dissolved by ether and somewhat by alcohol. Another substance almost invariably present in cytoplasm is cholesterin, a solid crystalline alcohol of somewhat uncertain constitution, insoluble in water and salt solution, but readily soluble in alcohol and ether. The remaining constituents of the cytoplasm are the inorganic elements calcium, magnesium, potassium and sodium united with chlorine and phosphoric acid to form chlorides and phosphates respectively. It may be somewhat questionable whether all of these latter salts are primary constituents of the cytoplasm, although it seems quite certain that potassium which is present in fairly large quantities in animal cells is a true primary constituent. Potassium phosphate is certainly

of primary importance for the life and development of the animal cell, as no doubt also are the earthy phosphates, although we can hardly formulate how they exist in the cytoplasm unless it be in close union with the proteids or nucleo-albumins of the cell, for which we know they have a strong affinity. Again, it is to be remembered that the ash of all cells shows the presence of a certain amount of ferric oxide. This, however, does not come from ordinary iron salts present in the protoplasm, but the iron appears to exist in some peculiar organic combination, apparently united to carbon. It is especially to be noted as a component of so-called iron-containing nucleins, or nucleo-albumins.

It is thus seen that proteid matter in some one or more forms, mostly as nucleo-albumins, constitutes the great bulk of cytoplasm, and the typical anabolic product of the living cell is unquestionably represented by a molecule, or molecules, in which proteid matter occupies a prominent place. "But that the albumin molecule is alone the bearer of life and all the other constituents of the protoplasm its satellites we certainly cannot affirm." (Kossel)

Between the cytoplasm and the karyoplasm there is very little constant difference. The one typical constituent of the cell nucleus, however, is nuclein or one of the bodies of that group. It is important to note in this connection that such examinations as have been made show that the primary constituents of the cell may be located in the nucleus in great part, or they may be evenly distributed through both cytoplasm and karyoplasm, or indeed they may be almost wholly wanting in the nucleus, occurring only in the cytoplasm.[5] This latter condition offers a ready explanation of the well-known fact that cells rich in nuclei and consequently containing only a little cytoplasm, as the spermatozoa, are extremely poor in many of the primary bodies of ordinary cells. The one body, however, characteristic of the cell nucleus is nuclein.

Cholesterin and lecithin are certainly common to both cytoplasm and karyoplasm, being found abundantly in cells rich

---

[5] Kossel. Verhandlungen d. physiol. Gesellschaft zu Berlin, Feb'y, 1890.

in nuclei as well as in cells poor in nuclear elements. We must reiterate, however, that the first place in importance among these so-called primary bodies is to be ascribed to the proteids in all living cells, for it seems more than probable that the nucleins and the lecithins found in cell protoplasm are constructed synthetically out of certain cleavage products of the proteids and phosphates. However this may be, the globulins, nucleo-albumins and nucleins are, so far as our present knowledge extends, the important constituents of cell protoplasm in all animal and vegetable cells. Of these three classes of bodies, the nucleins and the related nucleo-albumins are deserving of special notice.

The substance originally known as nuclein and first identified by Hoppe-Seyler and Miescher as the main constituent of the nucleus of pus cells was prepared by a number of investigators from different kinds of material rich in nuclei, or nuclear substance. Thus, Miescher prepared it from the spermatozoa of different animals, Geoghegan from the brain, Hoppe-Seyler from yeast cells, Plósz from the liver and von Jaksch from the human brain. The products obtained, however, while showing certain points in common, were unlike each other in many respects. Thus, they were all alike in containing a noticeable amount of phosphorus, but the percentage of phosphorus was found on analysis to vary from 1.8 per cent. up to 9.5 per cent. Again, the several products differed in their degree of solubility in alkalies, some being very soluble and others only slightly so. These marked discrepancies were naturally considered as implying that the so-called nuclein was not a chemical unit, but rather an indefinite mixture of organic phosphorus compounds with proteid matter; but we now know, thanks to the painstaking work of Kossel and others, that there are a group of closely related bodies, *nucleins*, widely distributed in nature, wherever cell structure is to be found, as the main constituent of the cell nucleus, and likewise present in certain substances such as milk and egg-yolk which serve as food for developing animals. The latter class are better known as nucleo-albumins, from which a typical nuclein can be separated or rather prepared by the

proteolytic action of the gastric juice,[6] which dissolves away the excess of proteid matter leaving a non-digestible nuclein. The essential points of difference between the typical nucleins are made clear by a study of their cleavage products. Thus, the nuclein found in the karyoplasm of most cell nuclei on being boiled with dilute sulphuric acid, yields as cleavage products, phosphoric acid, xanthin bodies and acid-albumin. The nuclein, on the other hand, present in the sperm of the salmon fails to yield any albuminous matter, its cleavage products being only phosphoric acid and hypoxanthin. The third group of nucleins, better known as nucleo-albumins, yield only phosphoric acid and albuminous bodies by cleavage, the xanthin bases, if formed, being in too small quantity to admit of certain detection. From the nuclein of yeast cells, Liebermann obtained by cleavage metaphosphoric acid, and both he[7] and Pohl were able to prepare a combination of metaphosphoric acid with egg-albumin, also with serum-albumin and with albumose, resembling nuclein in properties. Furthermore, by varying the proportions of acid and albumin it is possible to prepare different forms of nuclein, varying in their content of phosphorus, and in their solubility in alkalies, like the natural nucleins obtainable from cell nuclei. It is questionable, however, whether these synthetical products are in every way akin to the natural nucleins, for it seems probable that the nuclein molecule formed through the activity of the living cells is constructed on a somewhat different plan, so far as the arrangement of the atoms is concerned. Thus, Altman[8] has shown that when a nuclein is subjected to a mild process of decomposition, as on exposure to the action of an alkali at ordinary temperature, it is broken apart into albumin and a peculiar acid rich in phosphorus, to which the name of nucleic acid has been given. Moreover, it is possible to regenerate the nuclein out of these two components, the body so reconstructed having all the properties of the original substance. Nucleins, therefore, to quote Halliburton, may be considered

---

[6] Compare Lilienfeld Du Bois Reymond's Archiv f. Physiol. 1892, p. 129.

[7] Liebermann. Pflüger's Archiv für physiologie Bd. 43 p. 99.

[8] Ueber Nucleinsäuren. Du Bois Reymond's Archiv für Physiol, 1889, p. 524.

as compounds of proteid substances with nucleic acid, the various members of the group differing in the proportion of proteid matter to this phosphorus-rich acid. Thus, we may have a chain of nucleins, one end of the series being represented by nucleic acid itself with its 9 to 11 per cent. of phosphorus and without any admixed proteid, such for example as is found in the heads of the spermotozoa, which are doubtless derived from the nuclei of the spermatogenic cells; while in the middle of the series are the nucleins proper consisting of proteid with varying amounts of nucleic acid, and at the other extreme nucleins composed almost entirely of proteid, containing at the most only 0.5 to 1.0 per cent. of phosphorus and represented by the substances generally known as nucleo-albumins.

Nucleins are not digestible in artificial gastric juice, while a nucleo-albumin, as already stated, undergoes a partial digestion, the excess of combined proteid matter being converted into soluble products, while a typical nuclein remains as an insoluble residue, which however may be dissolved by weak alkalies. With this understanding of the general character of of the nucleins, many of the micro-chemical observations recorded by different workers in cytology become intelligible. Take as an illustration the work of Zacharias[9] on vegetable cells. This observer, as you remember, made a large number of digestive experiments with artificial gastric juice, and noted the occurrence in the nucleus of two distinct substances indigestible in pepsin-acid solution, which differed from each other in their solubility in acids and alkalies. As a result, Zacharias states that the resting cell nucleus consists of a ground mass composed in great part of nuclein, while the nucleoli consist of albumin and plastin. Remove the albumin from the nucleus by digestion, and the nuclein will dissolve in dilute alkali, leaving a network of plastin. Further, Zacharias states that plastin is an essential constituent of the total protoplasmic content of the cell, including the nucleus and the chromatophore. Now, note the differences between the nuclein and the plastin as defined by Zacharias. Plastin,

---

[9] Botanische Zeitung. 45th Jahrgang, pp. 281 and 329.

for example, does not dissolve or even swell up in 10 per cent. salt solution, hence it is not a globulin or simple proteid; further, it does not disappear on treatment with hydrochloric acid of moderate strength, as nuclein does. Again, plastin is much more difficultly soluble in alkalies than nuclein. Now as a matter of fact these two bodies have an extremely close relationship; they are both nucleins, having the same general type of structure; they differ merely in the proportion of nucleic acid and proteid. The plastin of the histologist, therefore, is simply a form of nuclein, less acid in character because it contains less nucleic acid and a larger proportion of proteid; hence, it likewise contains less phosphorus and for the same reason is more insoluble in alkalies.

In a general way we may say that the so-called nuclear sap or nuclear matrix is composed practically of a globulin-like body, just such as is found in the cytoplasm and which by digestion with artificial gastric juice is converted into soluble products, as proteose and peptone. The bulk of the nucleus, however, is composed of material insoluble in gastric juice. The bodies composing this indigestible matter are all phosphorized; in fact, they are nucleins of various kinds. Thus, the so-called chromatin network which is distinguishable from all other constituents of the cell by its strong affinity for various dyes is composed of a nuclein rich in phosphorus, viz.: a nuclein with a large content of nucleic acid and a correspondingly smaller content of proteid. The nucleoli, on the other hand, which have a less pronounced affinity for dyes than the chromatin, are composed mainly of the so-called plastin, *i. e.* a nuclein comparatively poor in phosphorus and not readily soluble in alkalies. In other words, and this I think is the point deserving of special emphasis, the cell nucleus in all cells is composed mainly of nucleins, compound bodies made up of proteid matter and nucleic acid, the latter rich in phosphorus, the individual parts of the nucleus varying somewhat in accord with the varying character of the nucleins as determined by the proportions of proteid to nucleic acid. That is to say, "in the processes of vital activtiy there are changing relations between the phosphorized con-

stituents of the nucleus, just as in all metabolic processes there is continual interchange, some constituents being elaborated, others breaking down into simpler products."[10] We are not to forget, however, that these bodies may possibly be fragments of still more complex molecules resident in the living karyoplasm of cell nuclei. In any event, the character of these fragments, if such they are, must tell us something as to the nature of the original molecules, and consequently on the basis of the above statements we may reasonably argue the probable existence of different, though closely related, chemical varieties of karyoplasm as peculiar to the cell nuclei of individual organs and tissues.

Lilienfeld,[11] however, while accepting in a general way the views already expressed emphasizes the probability that as a rule there is a constant difference between the nucleus and the body of the cell, in that the former in every phase of life consists mainly of nuclein substances, *i. e.*, nucleo-proteids, nuclein and in extreme cases nucleic acid, while the body of the cell is composed mainly of pure proteids and nucleo-albumins with a low content of phosphorus. But as there are changing relations between these individual bodies, the tone of color obtainable by different dyes is obviously more or less variable; but as a rule, we may say that the nuclein-containing bodies of the nucleus have the strongest affinity for basic dyes, while the proteids of the cell body naturally seize hold of the acid dyes.

Further, Lilienfeld, who has recently made a thorough study of the inner structure of leucocytes and has named the characteristic constituent of the nucleus, *nucleo-histon,* describes this body as a nucleo-proteid, a body comparable to a chemical salt composed of a proteid base, histon, and a complex acid, leukonuclein, which in turn is made up of nucleic acid and proteid. So that in this the latest work in this direction that I am familiar with, we find results all bearing out the general statements just submitted.[12] Again, Lilienfeld has shown

---

[10] Halliburton

[11] Verhandlungen der Berliner physiologischen Gesellschaft. Du Bois Reymond's Archiv für Physiologie. Jahrgang, 1893, p. 391.

[12] Compare Lilienfeld "Zur Chemie de Leucocyten." Zeitschr. Phyiol. Chem. Band. 18, p. 473.

that it is the nucleic acid of the nucleus which is the primary cause of the pronounced color shown by this portion of the cell on treatment with aniline dyes.

With this understanding of the wide-spread distribution of nucleins throughout all animal and vegetable cells, let us consider somewhat more in detail the character of their decomposition or cleavage products, for this may give us a clearer insight into their general nature. As already stated, the nucleins thus far studied yield on treatment with dilute mineral acids a row of peculiar crystalline nitrogenous products, the xanthin bases so-called, the true antecedent of which Kossel has shown to be nucleic acid. Hence, the yield of these bodies, which, by the way, belong to the uric acid group, must depend upon the amount of nucleic acid contained in the given nuclein. The wide-spread distribution of these bodies, throughout the animal organism especially, wherever cell activity is pronounced, their close connection with uric acid and their evident origin in the nucleic acid of cell nuclei are facts of great physiological importance, since they throw possible light upon the physiological function of the cell nucleus and at the same time point to a genetic connection between the nuclein bases and uric acid. This phase of the matter, however, we cannot now consider, but there are one or two points connected with these nuclein bases that we cannot afford to pass by. First, the bases themselves are four in number, viz.: adenin, guanin, xanthin and hypoxanthin, all well defined bodies of known chemical constitution. Among these, adenin stands foremost. It is, to be sure, the one most recently discovered, but its characteristic chemical nature and constitution give it a peculiar prominence the others do not possess. It is not only a product of the chemical decomposition of pure nuclein by dilute acids, but it is widely distributed in nature, and its distribution in the organs and tissues of animals and plants corresponds to its genetic relationship to the characteristic constituent of the cell nucleus. Thus Kossel[13] has obtained it from the pancreatic gland and from the spleen, also from yeast cells and from tea leaves, but found it

---

[13] Zeitschrift für physiologische Chemie. Band 12, p. 241.

wanting in muscle tissue, poor in nuclei. F. Kronecker[14] found it in the spleen, lymph glands and kidneys of oxen, while Stadthagen[15] found it present in the liver and urine of a patient suffering from leukæmia, a disease in which the white blood cells are enormously increased in number. It is not to be understood, however, that the adenin exists wholly free in these cases. On the contrary, it exists in plant and animal tissues in loose combination, in part at least, with albumin and phosphoric acid. This combination is easily broken by the action of dilute acids, especially at 100° C., and also by spontaneous decomposition after death, *i. e.*, the adenin is an integral part of the nucleic acid which is present in all cell nuclei, and under certain conditions can be split off from the complex molecule of which it is an integral part.

In composition, adenin is peculiar in that it contains no oxygen. It is composed solely of carbon, hydrogen and nitrogen in such proportion as to warrant the conclusion that it is a polymer of prussic acid, HCN. It has in fact the same percentage composition as prussic acid, and its ready convertibility into potassium cyanide by fusion with caustic potash at 200° C., testifies to the close relationship between these two bodies. The existence of cyanogen compounds in the animal body has long been suggested as theoretically probable, and the finding of adenin gives to this hypothesis a substantial basis and points to the cell nucleus as the seat of these cyanogen compounds. Further, adenin is closely related to hypoxanthin, a body with which we are more familiar and whose origin we shall need to consider. Moreover, we find when we come to study relationships that all the so-called nuclein bases are closely related to adenin, as is seen from the following formulæ, which bring out the analogies quite clearly:

Adenin	$C_5H_4N_4$ NH	Guanin	$C_5H_4N_4O$ NH
Hypoxanthin	$C_5H_4N_4$ O	Xanthin	$C_5H_4N_4O$ O

Both adenin and hypoxanthin contain a peculiar chemical group $C_5H_4N_4$, called by Kossel and Thoiss[16] adenyl, and we

---

[14] Virchow's Archiv. Band 107, p. 207.

[15] Ibid. Band 109, p. 390.

[16] Zeitschrift für physiologische Chemie. Band 13, p. 396.

may consequently consider adenin as adenylimid, while hypoxanthin may be appropriately termed adenyloxide. As might be expected from the close relationship between these two bodies, adenin can be readily converted into hypoxanthin; and in a similar manner the allied base guanin can be transformed into xanthin. Thus, Schindler[17] finds by experiment that adenin dissolved in water and exposed to putrefaction at about 20° C. with exclusion of air, in time entirely disappears, a large amount of hypoxanthin appearing in its place and likewise a trace of xanthin. In other words, oxygen-free adenin is made by this process to combine with oxygen, being converted into the related oxygen-containing body hypoxanthin, with a giving up of ammonia. Guanin by a like method of treatment is changed into xanthin. The reactions involved are very simple as the following equations show:

$$\underset{\text{Adenin}}{C_5H_5N_5} + H_2O = \underset{\text{Hypoxanthin}}{C_5H_4N_4O} + \underset{\text{Ammonia}}{NH_3}$$

$$\underset{\text{Guanin}}{C_5H_5N_5O} + H_2O = \underset{\text{Xanthin}}{C_5H_4N_4O_2} + \underset{\text{Ammonia}}{NH_3}$$

We thus have every reason for believing that when hypoxanthin results from the breaking down of nuclein it passes through the intermediate stage of adenin. In other words, adenin is a primary cleavage product of nuclein, or rather of nucleic acid, while hypoxanthin is a secondary product coming directly from the adenin. In a similar manner, guanin is a primary decomposition product of nucleic acid, xanthin being in the same sense a secondary product. These four bases are plainly closely related and intimately associated in many ways, and all are alike cleavage products of the nuclein obtainable from cell nuclei. But the primary bodies adenin and guanin are evidently far more susceptible to the changes going on in living cells than their neighbors hypoxanthin and xanthin. All four, however, are capable of complete decomposition with formation of a variety of decompo-

---

[17] Zeitschrift für Physiologische Chemie. Band 13, p. 432.

sition products. In this connection, one of the most instructive series of changes adenin undergoes outside the body is that induced by long-continued warming with dilute hydrochloric acid, in which it is completely broken down into ammonia, carbonic acid, formic acid and glycocoll or amido-acetic acid. Xanthin and hypoxanthin furnish the same products by like treatment:

$C_5H_5N_5 + 8H_2O = 4NH_3 + CO_2 + 2H{-}COOH + CH_2{-}NH_2{-}COOH$
Adenin. Formic Acid. Glycocoll.

$C_5H_4N_4O + 7H_2O = 4NH_3 + CO_2 + 2H{-}COOH + CH_2{-}NH_2{-}COOH$
Hypoxanthin.

$C_5H_4N_4O_2 + 6H_2O = 3NH_3 + 2CO_2 + H{-}COOH + CH_2NH_2{-}COOH$
Xanthin.

Again, adenin can be easily decomposed completely into carbonic acid and ammonia, but the most striking fact in connection with this body, as already stated, is its easy convertibility into cyanide of potash, indicating as it does the close relationship existing between this substance and the cyanogen group.

In attempting to ascribe a function to adenin that shall correspond to the accepted function of the cell nucleus, we must have proof that this substance, under conditions which obtain in the body can readily pass into new forms easily capable of undergoing reactions. As has been shown by experiment, the conditions for vigorous reduction processes are present in every cell. Reduction gives a blow by which the oxygen-free adenin may be transformed into a new body having a strong avidity for oxygen, and which may in turn be transformed through the laying on of more molecules into a body resembling, if not identical with, azulminic acid. Adenin, for example, dissolved in dilute hydrochloric acid and treated with zinc is quickly decomposed by the reducing action of the nascent hydrogen evolved into what is evidently azulminic acid $C_4H_5N_5O$, a derivative of dicyan. If dicyan

$\begin{array}{c}CN\\ |\\ CN\end{array}$

is simply dissolved in water and allowed to stand exposed to the air for a long time, the solution gradually becomes dark in color, accompanied by a dissociation in which formic acid, prussic acid, oxalate of ammonia and urea result, together with a certain amount of azulminic acid; reactions which again emphasize the cyanogen-like character of the adenin molecule.

Such being the nature of adenin, it is not to be doubted that bodies emanating from this substance with strong affinities must be important actors in the physiological and chemical processes, especially those of a synthetical order, going on in all cellular tissues. In this connection it is to be remembered that Pflüger on purely theoretical grounds ascribed great importance to the physological rôle played by the cyanogen group with polymerization, etc., in the living albumin molecule. Dead albumin, such as we see in the white of egg, blood-fibrin, etc., is a comparatively stable substance, indifferent to neutral oxygen, not readily prone to change, and yielding decomposition products by no means identical with the cyanogen-like bodies resulting from normal proteid metabolism.[18] Evidently then the dead food-albumin in being assimilated is reconstructed on a different plan, the atoms are rearranged and in the living albumin molecule, as in the protoplasm of the cell, we are lad to infer a close union of the carbon and nitrogen with formation of the comparatively unstable cyanogen group. In the dead protoplasm, on the other hand, the nitrogen of the proteid is joined directly with hydrogen to form amidogen (NH_2), but in the processes of anabolism going on in all living cells, the nitrogen is detached from the hydrogen and made to combine more directly with carbon to form the more unstable group CN. As a result, the katabolic products of proteid metabolism known to us are the cyanogen-containing bodies, guanin, uric acid, creatin and the related body urea. These are products of the katabolism of living protoplasm, and in the discovery of adenin and its close relationship to the typical xanthin bases we have added proof of the existence of cyanogen-containing radicals in the protoplasm of the cell, especially in the karyoplasm of the nucleus. In all of these xanthin

---

[18] See Drechsel, however, Der Abban der Eiweissstoffe. Du Bois Reymond's Archiv, 1891, p. 248.

bodies there is to be seen a peculiar combination of carbon, nitrogen and hydrogen such as is not found in dead proteid matter. The structure of the molecule is different and is emblematical of a still more complex molecule in which the atoms are similarly arranged.

Thus, it is to be remembered that whenever an organ rich in cells is decomposed by dilute acid, adenin, guanin, xanthin and hypoxanthin are never obtained alone. They are not found as individuals, but in every tissue which has retained its original condition, the two special xanthin bases, for example, are found in combination with other groups of atoms, especially with phosphoric acid and albumin, as parts of a higher compound, the nuclein. From this higher compound, the individual components cannot be extracted by simple solvents or other like methods of isolation; a blow must be struck by which the complex molecule shall be shattered and the individual parts liberated, as by the action of a dilute mineral acid. In tissues very poor in nuclear elements, on the other hand, as in muscle tissue, we find only the decomposition products of nuclein; the chemical union between the individual fragments is broken, and the phosphoric acid, for example, no longer exists in organic combination, but as soluble alkali phosphates. In a similar manner, the xanthin and hypoxanthin exist in a free condition capable of extraction by water alone.

Further, in the transformation of adenin and guanin into hypoxanthin and xanthin respectively, with a splitting off of the NH group and the acquisition of oxygen we have a possible illustration of the manner in which the migration of the amidogen group of albumin to urea takes place; a transformation which no doubt goes on in the tissues and perhaps in every cell nucleus.

Certainly then in the light of what has been said, the cell nucleus may be looked upon as in some manner standing in close relation to those processes which have to do with the formation of organic substances. Whatever other functions it may possess, it evidently, through the inherent qualities of the bodies entering into its composition, has a controlling

power over the metabolic processes going on in the cell, modifying and regulating the nutritional changes.[19] And you will notice that I lay great stress upon the chemical nature of the karyoplasm, the inherent qualities of the plasm as indicated by its molecular condition. It is not the mere fact that the karyoplasm is housed, so to speak, in a certain definite structure that it is possessed of its characteristic qualities, but the qualities are peculiar to the living molecules themselves. The living molecules are different from the dead molecules because they have a different chemical constitution, the atoms are arranged in a different manner. All this being true we can easily see how cells devoid of specific nuclei may perhaps be functionally active, to a slight extent, provided they contain the same chemical groups in the cytoplasm.

But I have already exceeded the alloted time, while there is much that might be said. Still, the foregoing will indicate in a limited way that there is a field of work in connection with the chemistry of the cell that cannot consistently be ignored in biological inquiries.

---

[19] Compare M. Verworn, "Die physiologische Bedeutung des Zellkerns." Pflüger's Archiv f. Physiol. Band 51, p. 1.

THE CLASSIFICATION OF THE ARTHROPODA.

By J. S. Kingsley.

In the concluding section of my paper on the Embryology of Limulus ('93), I expressed my views upon the classification of the Arthropods. The following is to be regarded as an expansion of the remarks I then made, with the inclusion of some matter not then available.

Since the days of von Siebold ('46), the naturalness of the group of Arthropoda has been almost universally recognized, only a few, like the present writer ('83) and von Kennel in his recent text-book of Zoology ('93), appearing to doubt the homogeneity of the division. On the other hand, the way in which the Arthropoda should be subdivided has been very differently regarded by different authors. Space will not permit an extended résumé of the growth of our knowledge, but it is fair to say that almost every person treating of the subject has added materially to the basis for a natural classification, either by the discovery of new facts or by throwing new light upon facts known before. At present, the great majority of naturalists divide the Arthropod phylum into two groups or sub-phyla, which, however named, are essentially Branchiata and Tracheata, the former embracing the Trilobites, Eurypterids, Hemiaspids and Xiphosures, along with the true Crustacea; the latter containing the Onychophora (Peripatus) Myriapods, Hexapods and Arachnids.

Yet this division is not universally accepted, and a few years ago, Professor E. Ray Lankester, following out the earlier suggestion of Strauss-Dürckheim and the later one of the younger van Beneden ('71), demonstrated that the affinities of Limulus were with the the Arachnids rather than with the Crustacea. This epoch-making paper—"Limulus an Arachnid"—must form the basis of all farther studies of Arthropod taxonomy, since it logically follows from his conclusions that the distinctions made between Branchiata and Tracheata are physiologi-

cal rather than morphological, and that their emphasis tends to obscure true relationships upon which alone a natural system can be based. Since Lankester wrote, most students of Arachnid morphology and every one (excepting Professor Packard) who has investigated the structure or ontogeny of Limulus, have endorsed the general conclusion that Limulus is closely related to the Arachnids.

This being the case, Lankesters's later views upon the subdivision of the Arthropoda possess a peculiar interest. In the ninth edition of the Encyclopedia Britannica, article "Zoology," he gives the following arrangement:

- Branch Arthropoda.
  - Grade 1, Ceratophora.
    - Class I, Peripatidea.
    - Class II, Myriapoda.
    - Class III, Hexapoda.
  - Grade 2, Acerata.
    - Class I, Crustacea.
    - Class II, Arachnida.
    - Class III, Pantopoda,
    - Class IV, Tardigrada.
    - Class V, Linguatulina.

Professor Claus is apparently not so radical in his ideas. I fail to make out from his various polemical articles ('86 $^{a, b}$., 87 ^{a}) exactly what his later views are, but in the fourth edition of his Lehrbuch ('88)—the fifth edition is not at hand —there is such a lack of regularity in the subordination of type, headings, etc., that it is difficult to ascertain his opinions. As I interpret him, he has the following scheme:

- Arthropoda.
  - Class 1, Crustacea.
    - Sub-Class I, Entomostraca.
    - Sub-Class II, Malacostraca.
    - Gigantostraca.
      - Merostomata.
      - Xiphosura.
  - Class II, Arachnoida.
  - Class III, Onychophora.

Class IV, Myriapoda.
Class V, Hexapoda.

From this it would seem that the only conclusions which can be drawn are that, at least at this date, Professor Claus regarded the Gigantostraca as a subdivision of the Crustacea, but was uncertain whether to regard it as equivalent to the Entomostraca and Malacostraca or not.

It is impossible to give the views of Hatschek, as the part of his "Zoologie" treating of the Arthropods has not yet appeared. In his general table ('88, p. 40) he accepts, in a modified way, the Articulata of Cuvier, and regards the Onychophora as a class, of equal rank with the Arthropoda.

The earlier studies of Boas upon the classification of the Crustacea possess such value that his general ideas upon the subdivisions of the Arthropoda deserve mention. In his "Zoologie" ('90) he adopts the following arrangement:

Arthropoda.
  I Class, Crustacea.
    I Sub-Class Entomostraca, including as Orders: I, Phyllopoda; II, Cladocera; III, Xiphura (*sic*); IV, Trilobitæ; V, Ostracoda; VI, Copepoda; VII, Cirripedia.
    II Sub-Class, Malacostraca.
  II Class, Myriapoda.
    (Peripatus doubtful.)
  III Class, Insecta.
  IV Class, Arachnida.

Lang ('88) has the following classification:

Arthropoda.
  I Sub-Phylum, Branchiata.
    Only class Crustacea.
      First "Anhang to Branchiata—Trilobita, Gigantostraca, Hemiaspidæ, and Xiphosura.
      Second "Anhang"—Pantopoda.
  II Sub-Phylum, Tracheata.
    I Class, Protracheata.
    II Class, Antennata (Myriapoda and Hexapoda).
    III Class, Chelicerotæ *sive* Arachnoidea.
      "Anhang" to Arthropoda—Tardigrada.

Fernald has approached the subject from the standpoint of Hexapod morphology. He gives ('90) a phylogenetic tree in which two main trunks arise from the primitive unsegmented worm. One of these embraces the Annelids and Peripatus, the other includes the Arthropods proper. This latter branches into the Hexapods and the Crustacea, the Arachnids and Limulus being represented as offshoots from the main Crustacean line. The origin of the Myriapods is left in doubt, but of the two divisions the Chilopods are represented as an offshoot from the Diplopod stem.

Richard Hertwig ('92) adopts the following scheme:

Branch Arthropoda.
  I Sub-Phylum, I Class, Crustacea.
    1 Sub-Class, Entomostraca, containg as regular members the Orders: I, Copepoda; II, Branchiopoda; III, Ostracoda; IV, Cirripedia; and, as "Anhangen," V, Xiphosura; VI, Trilobitæ; VII, Gigantostraca.
    II Sub-Class, Malacostraca.
  II Class, Onychophora.
  III Class, Myriapoda.
  IV Class, Arachnoida (including Pantopoda as an "Anhang").
  V Class, Hexapoda.

Lastly, von Kennel, whose studies on Peripatus entitle his views on Arthropod taxonomy to a hearing, denies ('93) the validity of the group Arthropoda, claiming that those features which would seem to unite the Tracheata and Branchiata are either superficial or are common to the whole series of metameric Invertebrata. He places the Xiphosura among the Crustacea, apparently regarding them as equivalent to the rest of the group. The Tracheata are divided into three sub-classes, Myriapoda, Hexapoda and Arachnoida, the relationships of Tardigrada and the Pycnogonida being regarded as uncertain.

My own views, as stated in my last paper on Limulus, have not undergone any extensive modification, although the tabular statement has undergone some slight changes. Chief of these is the transfer of the Trilobitæ from a position of uncertainity to a more close union with the true Crustacea, a matter

which will be referred to again below. I would now present the following scheme:

- Phylum Arthropoda.
  - Sub-Phylum I, Branchiata.
    - Class I, Crustacea.
      - Sub-Class I, Trilobitæ.
      - Sub-Class, II, Eucrustacea.
    - Class II, Acerata.
      - Sub-Class I, Gigantostraca.
      - Sub-Class II, Arachnida.
  - Sub-Phylum II, Insecta.
    - Class I, Chilopoda.
    - Class II, Hexapoda.
  - Sub-Phylum III, Diplopoda.
- Incertæ Sedes—
  - Pycnogonida.
  - Linguatulina.
  - Pauropoda.
  - Tardigrada.
  - Malacopoda.

The various papers by Lankester, McLeod, Laurie and myself have, I think, clearly shown that the older grouping of the Arthropoda into Branchiates and Tracheates is not justified by the facts of structure and ontogeny; that tracheæ are not homologous structures in all Arthropods which possess them, and that the old group of Tracheata is polyphyletic in origin. Since classification must represent the various lines of descent, the old must therefore go. There remain many points which must be investigated anew, but I feel confident that further research will support, in its main features, the classification adopted above, and considered more *in extenso* below.

PHYLUM ARTHROPODA.

I am not prepared to discuss the validity of this group, although for reasons that will appear below, I am inclined to believe the great divisions which I recognize are but remotely related to one another, and it may yet be proved, as I suggested several years ago ('83), and as von Kennel believes, that

they have no common ancestor nearer than the Annelids. The jointed nature of the appendages offers no insuperable objection to this view, while the early phases of the egg, the formation of the germ layers, the structure of the alimentary canal, the morphology of the reproductive and excretory organs, as well as certain facts concerning the circulatory, respiratory and nervous systems are easiest explained upon such an hypothesis. The presence of compound eyes in branchiate and tracheate forms would, at first thought, be a strong argument for the older views, but these organs differ so greatly in their structure that it is easier to regard them as homoplastic organs (comparable in a way to the eyes of Cephalopods and Vertebrates) rather than as derivatives from a common compound ancestral visual organ. For our present purposes, the group of Arthropoda may be retained as a convenient assemblage, characterized in the following manner: Heteronomously segmented animals, with, typically, a pair of appendages to each somite; the whole enclosed in a chitinous segmented exoskeleton, the jointing of which extends to the appendages, thus justifying the term Arthropoda. The appendages, primitively locomotor in function, may be modified, on one or more somites, for the taking or commuting of food, for respiration, copulation, oviposition, sensation, fixation, etc. No circular layer of muscles in body wall; nervous system consisting of a pair of primitively supraœsophageal ganglia and a ventral chain of paired ganglia, of which one or more pairs may, in the course of development, be transferred to the prestomial region. Eyes, simple, aggregate, or compound, with, in some cases, an inversion of the retinal layer. Cœlom small, inconspicuous; circulatory organs consisting of a dorsal heart enclosed in a vascular pericardial sac; blood-vessels more or less evidently metameric, terminating in "lacunar" spaces. Respiration, either by the entire surface of the body or by specialized outgrowths or involutions of the same. Excretion, either by true nephridia or by Malpighian tubules, developed from either the mid- or the hind-gut. Reproductive organs consisting of gonads developed from the cœlomic walls and with modified nephridia serving as efferent ducts.

In order that we may compare, part with part, the different forms of Arthropods, it becomes necessary to assume some basis of comparison, and apparently the only one available is that of the exact homology of the similarly situated meta meres in the different groups, but here we meet with a difficulty. How can we be certain, for example, that somite 10 of the lobster is the exact homologue of somite 10 in the beetle? How can we tell that no somite has been lost in the evolution of these different lines? Perfect certainty is impossible, and we now know that in the serial comparisons of not more than five years ago, errors crept in, because there is a tendency of somites to become aborted or obsolete. This tendency is well-known in cases of Apus and Oniscus, where one of the anterior pairs of appendages is greatly reduced ; and in Limulus, Scorpions, Moina, etc., where an anterior somite is not differentiated until after those behind it. In many forms there is an obliteration or a fusion of cœlomic cavities in the anterior region, the mesoderm flowing together as a common mass.

On the other hand, the embryonic phases of the nervous system seem to give clear indications of neuromeres in the anterior end of the body, and, as farther back, neuromeres correspond to the mesodermic metameres, it is reasonable to accept until error be shown, a somite for each neuromere at the anterior end of the Arthropod body. Unfortunately, we have detailed knowledge of these neuromeres in but few cases, and even in these there is a lack of uniformity in the observations.

In the Hexapods it has been shown that the "cerebrum" of the adult is composed of at least three pairs of ganglia called by Vaillanes, respectively, the protocerebrum, the deutocerebrum and the tritocerebrum. These elements have been recognized by Tichomiroff in the silkworm (teste Cholodkowsky) in Acilius (Patten, '88), in Blatta (Cholodkowsky, '91), in Mantis (Vaillanes, '91), in Xiphidium and Anurida (Wheeler, '93), while Carrière ('90) has described *four* cerebral elements in Chalicoderma. The figures of the latter author do not seem to me conclusive, and I am inclined to believe the more numerous observations in this difficult field as the more probably correct.

These cerebral elements apparently have different values. So far as observations go, the protocerebrum is always preoral, and in no case is any appendage developed in connection with it. Apparently, the region in which it occurs is to be compared to the preoral lobe of the annelids, while the two ganglia of which it is composed would correspond to the "Scheitelplatte" of German embryologists. The other cerebral elements, on the other hand, are primitively behind the stomodæum, and, in some forms at least, an appendage is developed in connection with each. Thus the antennæ belong to the deutocerebral neuromere, while in Anurida Wheeler has shown that the tritocerebral neuromere possesses at an early stage a pair of small appendages, which here, as in all Hexapods, is absent from the adult.

In the Crustacea, not a few observations go to show somewhat similar conditions. We find there a protocerebrum without appendages at any stage, followed by a series of ganglia which present many claims to belong to the postoral series. In a paper on the Embryology of Crangon ('89), I claimed that in that form the antennæ were primitively postoral, but since the validity of my observations have recently been questioned by Weldon ('92) and Herrick ('92),[1] they must be repeated before they can be accepted. Aside, however, from these questionable observations, there are many other facts which go to show that the antennal neuromeres belong to the the postoral rather than to the prestomial series. There is, however, less evidence for this position for that pair of ganglia which exist in the lobster (see Bumpus ('91), pl. XVII, fig. 1), between the protocerebral ganglia and the neuromeres of the antennæ. It is without appendages, and although its fate has not been traced, it probably becomes fused in the "cerebrum" of the adult.[2] This neuromere is, I am inclined to think, also to be regarded as belonging to the same series as that of the antennæ.

---

[1] For some remarks upon these criticisms, see my paper ('93), p. 235, foot-note.

[2] Professor J. P. McMurrich informs me that he has found these deutocerebral ganglia in the various Isopods (Jæra, Oniscus, Porcellio, Armadillidium, etc.) which he has studied.

In the Arachnids and the Xiphosures, we have evidence of several elements in the "brain." Both Patten and myself have shown the existence of three pairs of cerebral ganglia in Limulus, in front of the ganglia of the first pair of appendages. Patten finds ('90) the same number in the brain of the Scorpion, as do Locy ('86, pl. XI, fig. 70) and Kishenouyi ('90) in Agalena. The copies of Morin's figures given by Korschelt and Heider ('92, fig. 383 B) seem also to be in full harmony. On the other hand, Schimkewitsch (87, pl. XXI, fig. 3) represents two pairs of ganglia in Epeira in front of the ganglia of the first pair of appendages, while in the diagrammatic figure (pl. XXIII, fig. 5) he apparently indicates four pairs of preappendicular ganglia.

In other groups of Arthropods I know of no detailed observations which can be used to aid in the enumeration of the neuromeres in the anterior region of the body. If we assume that in the cases of Hexapods, Crustacea, Xiphosures and Arachnids, the neuromeres enumerated above represent the total somites in this region, we may then compare, somite by by somite, these groups in the following manner:

	HEXAPOD.	ARACHNID.	XIPHOSURE.	CRUSTACEA.
Neuromere I	No Appendage	No Appendage	No Appendage	No Appendage
" II	Antenna	No Appendage	No Appendage	No Appendage
" III	Appendage	No Appendage	No Appendage	Antennula
" IV	Mandible	Chelicera	1st Leg	Antenna
" V	Maxilla	Pedipalpus	2d Leg	Mandible
" VI	Labium	1st Leg	3d Leg	Maxilla 1
" VII	1st Leg	2d Leg	4th Leg	Maxilla 2
" VIII	2d Leg	3d Leg	5th Leg	Maxilliped 1
" IX	3d Leg	4th Leg	6th Leg	Maxilliped 2

Of course it will be understood that this grouping is limited by our present knowledge, and that at any time discoveries may be made which will overturn it. It is, however, to be noted that it brings the hinder margins of the thorax of the Hexapoda and of the cephalothorax of Limulus and of the

Arachnids into exact correspondence. In the case of the Crustacea the corresponding line passes behind the third maxilliped of the Decapod.

If it should, however, be shown (as many believe) that the Crustacean metastoma has its own somite, the line will be thrown forward to behind the second maxilliped, and it will correspond to the line of division between the head and thorax of the Edriophthalmia.

Since the older ideas of numerical sequence are better known, I have used them in the following discussion rather than that based upon the neuromeres. Thus in the Hexapods somite (or appendage) I=Neuromere II; in the Arachnid and Xiphosures somite I = Neuromere IV; in the Crustacea somite I = Neuromere III.

The morphology of some other organs call for a moments' consideration. Prominent among these are the vasa Malpighii. These are usually regarded as characteristic of the "Tracheates," and their presence in the Arachnids has been adduced as a strong argument for their association with the Hexapods. It has been, however, pretty conclusively shown that these organs are not homologous throughout the Arthropod phylum, for in the Hexapod they are derived from the hind-gut, and are therefore ectodermal, while in the Arachnida, as Loman ('86–7) has shown, they are derivatives of the mesenteron and are consequently entodermal. Their similarities are those of homoplassy rather than of homology, and the only argument that can be drawn from the occurrence in these forms is that Arachnids and Hexapods are not closely related. Similar organs with similar functions have been described in various Edriophthalmia, but we are yet in doubt as to their origin. The studies of Spencer ('85) represent them as without chitinous intima in the Amphipods. They may, therefore, be entodermal. A detailed study of the region of the hind-gut of certain Decapods might give results interesting in this connection.

The tracheæ furnished another instance of homoplassy. These organs furnish the chief ground for the group called "Tracheates," since in most they form the sole means of res-

piration. Yet these are, in the opinion of many, not homologous. In the Hexapoda they arise, ontogenetically, as inpushings of the ectoderm of sides of the body, outside and above the line of the insertion of the limbs. Their method of growth, the general structure, etc., all point to their origin, as was pointed out by Chun ('75) from dermal glands which later assumed respiratory functions. The tracheæ of the Arachnids, on the other hand, have had a different origin. In those forms in which they have been studied, they arise as inpushings behind the temporary appendages on the abdomen. There is not a little evidence to show that they have arisen from gills borne on the posterior surfaces of these appendages, as in the Limulus of to-day; that they have been pushed into the body, taking the form of lung books, a condition permanent in all the respiratory organs of the Scorpions and in those of one or two somites of the Araneina; and then, coincidently with a reduction in the circulatory organs, they have penetrated farther and farther into the body. For the details of this process, as well as for the wonderful histological similarity between the embryonic gills of Limulus and lungs of Arachnids the reader is referred to my full paper. The "spiral threads" in the two cases are to be explained as mechanical in origin—corrugations give greater strength without excessively thickening the intima. Still, a third type of "trachea" is to be be found in the gills of the Oniscid Crustacea. These organs have become adapted for aerial respiration, and, in connection with this change, the organs have been permeated by branches of minute tubes, lined with a chitinous intima, produced by inpushings of the outer body wall. These tracheæ cannot be regarded by the strongest advocate of the naturalness of the "Tracheates" as homologous (*i. e.*, homogenous) with those of the Hexapods. I have made a number of, as yet unpublished, observations on these organs in Porcillio. Leydig described them in detail some years ago ('78). The peculiar structures in the genus Tylos as described by Henri Milne-Edwards ('40, p. 187–8) should be considered in this connection.

It is only recently that the existence of nephridia in the Arthropoda has been placed beyond a doubt. The earlier students

of the shell gland of the Entomostraca often made comparisons between it and the "segmental organs" of the Annelids, but the trouble was that the former terminated blindly internally, while in the Annelids the organ formed a tube connecting the body cavity (cœlom) with the interior. The problem was solved by Sedgwick ('88), who showed that in Peripatus the nephridia were closed internally, but that they were still nephridia as proved by development, and that we have here to deal with a greatly diminished cœlom. In the light of these facts it is now placed beyond a doubt that in the antennal and shell glands of the Crustacea, and in the coxal glands of Arachnids and Limulus, we have true nephridia.[3] In all there is the formation of a cœlom, a division of the cœlom of certain somites into dorsal and ventral moieties, and a development of the lower portion into end sac and nephridial tube, the latter portion breaking through to the exterior.[3]

Following the discoveries by Sedgwick that the genital ducts of Peripatus were modified nephridia, came the observations of Heymons ('90), Cholodkowsky ('91) and Wheeler ('93), all of which show that exactly the same conditions exist in the Hexapods, while Laurie ('90) has demonstrated that it is at least probable that the same holds true for the Scorpions. I made no observations on the origin of the genital ducts of Limulus, and I do not recall any account of their development in the Crustacea. In the latter group, however, there is not a little evidence of an anatomical character which is easiest interpreted upon the same hypothesis. There these ducts are metameric, and may occur in different somites in the different sexes. This condition is to be explained in two ways, as has previously been pointed out by Lankester. Either the ducts are to be regarded as new formations, or they are previously existing structures modified for reproductive functions exclusively. That this latter is the case, and that the ducts are nephridial is rendered probable by the following considera-

---

[3] These organs have been shown beyond a doubt to be mesodermal by Grobben ('79), Kingsley ('89, '90 and '93), Kishenouyi ('91), Lebedinsky ('92), Laurie ('90), etc., and yet Bernard ('93), with these facts available, has recently attempted to derive these structures from the glands of annelids—ectodermal structures—ignoring the facts presented by those who have actually investigated the subject.

tions: In all metameric animals one or more pairs of nephridia serve as genital ducts, and no case is known of the formation of new outlets. The genital ducts are so related to the gonads and these latter to the cœlom, at least in the Decapods (*cf.* Weldon, '89, '91) that we must regard the genital epithelium as cœlomic, and the ducts as ventral diverticula of the same space.

The salivary glands afford some difficulties, for they occur in most " Tracheates," and are usually stated to be absent from the " Branchiates." This apparent difference between the two groups is possibly to be explained by the different method of life—aquatic in the latter, terrestrial in the former. It is, however, to be noted that salivary glands have been recognized in Astacus (*cf.* Lang, '89, p. 344), while renewed studies must be made of the so-called salivary glands of the Arachnida before we are certain of their homology with those of the Hexapods. Several organs which have been called salivary glands among the spiders and their allies have been shown to be coxal glands (*i. e.* nephridia) or poison glands, and it is possible that all of these organs may have different homologies than those indicated by the name usually applied to them.

A group of structures which cannot, as yet, be discussed, is that of the embryonic membranes. In the Scorpions as in the Hexapods, the embryo develops those as yet unexplained fœtal membranes which so closely simulate those of the higher vertebrates. It may be that here, as in other places, we have similar but not identical organs. The accounts of their development in the Arachnids by Metschnikoff, Kowalevsky and Schulgin, and Laurie differ considerably, and, until we know something of the ancestry and real meaning of the structures which are united under this head we cannot be certain of the taxonomic value to be placed upon them. It may be noted here that the structures described by Bruce ('87) as occurring in the spiders are, in all probability, not amnion and serosa, but either invaginations in connection with the brain or the inpushing to form the median eye.

SUB-PHYLUM I—BRANCHIATA.

Arthropods breathing by means of gills (or lungs or tracheæ modified from gills) developed in connection with the appendages; without distinctly differentiated head, with long stomodæum, nephridia persisting in somite II or V (or both), genital ducts opening near the middle of the body. Anterior appendages all multiarticulate, the basal joints of one or more pairs serving as organs of manducation. A chitinous entosternite and deutova frequently present.

I hardly think it necessary, each time the limits of a group are changed, to give the new combination a new name. Our nomenclature is already cumbersome enough, and the slight indefiniteness is vastly preferable to the confusion of the other course. I have, therefore, retained the term Branchiata for the enlarged group, since I regard the lungs and tracheæ of the Arachnids as but modified branchiæ. In only the Edriophthalmia and certain Phyllopods do we have a distinctly differentiated "head," and the head in these groups is not the same in its limits. Under the head of nephridia I include the antennal and shell glands of the Crustacea and the coxal glands of the Arachnids and Limulus. The former have been shown by numerous observers to be true nephridia, while the observations of Laurie ('90) and Lebedinsky ('92), Sturanay ('91), are conclusive to the Arachnids. The observations of Gulland ('85), Kishenouyi ('91) and myself ('85 and '93) would seem to settle the matter in the Horse-shoe crab.[4] That the genital ducts are to be regarded as modified Nephridia has already been shown. Their position is inconstant in the Crustacea, varying in some forms with the sexes of the same species. In some of the more reduced forms, as the cirripeds, they are apparently almost terminal, a condition to be explained by the

---

[4] In my first paper on the development of Limulus, I pointed out that the coxal glands of Scorpio and Limulus were apparently homologous with the shell gland of the lower Crustacea, since in both cases they open at the base of the fifth pair of appendages. This identification is apparently not pleasing to Professor Claus ('86, since he has seen fit to ridicule my ideas of homology. I confess that I do not understand his objections, and certainly the evidence derived from the neuromeres (admitting one for metastoma of the Crustacea—*cf.* Brooks, '82), seems fully to support my thesis.

small number of metameres that become differentiated. Other features which are common to most Branchiates, but which either are not common to all or are at the same time common to some of other groups, will appear below. It must, of course, be understood that in the above diagnosis of the group, features of internal anatomy are known only of recent forms; of the visceral structure of the trilobites, we are absolutely in the dark.

CLASS I—CRUSTACEA.

Branchiate Arthropoda with functional gills; with one or two pairs of distinctly preoral appendages (antennæ) the first being purely sensory; the ganglia corresponding to these appendages being fused with the protocerebrum to form the "brain;" the appendages with typically a basal joint giving rise to two or three branches; several pairs of appendages modified for eating; alimentary canal with long œsophagus and well-developed stomodeal "stomach," mid-gut region short, the mid-gut glands ("liver") being well-developed; proctodeum long.

In all living Crustacea (Eucrustacea), there are two pairs of antennæ, although in some forms (e. g., Apus, Oniscids) one or the other pair has has become greatly reduced. In the Trilobites, on the other hand, but a single pair has, as yet, been discovered. It therefore remains to be shown whether a single pair is characteristic of these forms, or whether we have here a possibly greatly reduced additional pair. In case the former alternative prove true, it may be necessary to remove the Trilobites completely from the position here assigned them, though it will not necessarily follow that they should be associated with the Eurypterids and Limulus. (For the position of the Trilobites, see below).

It is difficult to say exactly what weight should be given the so-called "typical Crustacean limb," the di- or trichotomous appendage so frequently met with in this class, and which is not infrequently regarded as diagnostic. That this condition is a derivation of the lamellate condition found in Apus, as maintained by Lankester ('81) admits of little doubt, and

hardly more doubtful is the view which would compare the Phyllopod appendage with the Annelid parapodium. But two- and three-branched appendages are not unknown outside the Crustacea. One of the arguments advanced in favor of a Crustacean position for Limulus is that the abdominal appendages in that form are two-branched, while numerous observers have recorded a biramous condition in the appendages of the young of various "Tracheates." Among others we would mention the biramous pedipalps in Dendryphantes recorded by Croneberg ('80), the biflagellate antenna of an Indian Lepisma, and of an embryo *Blatta javanica* by Wood-Mason ('79), the bifid condition of the antenna of Blatta by Wheeler ('89), while Patten ('84), in the same form, describes the maxillæ and labium as "formed respectively of two and three branches, the second maxillæ thus attaining the typical trichotomous structure of the Crustacean appendages." Similar observations have been made upon other Hexapods, while in the Pauropida the trichotomous antennæ are to be called to mind.

Fully as characteristic is the extreme reduction of the entodermal portion of the alimentary canal proper, the entoderm cells being largely confined to the liver or mid-gut gland, while the canal itself is almost entirely composed of stomodeal and proctodeal invaginations (*cf* Kingsley, '89, pp. 13-19).

SUB-CLASS I—TRILOBITÆ OR PALÆOCARIDA.[5]

Fossil Crustacea with tri-regional body—head, thorax, pygidium, all bearing appendages. "Head" unsegmented, with one pair of antennæ and with four pairs of postoral appendages, all pediform and with basal points manducatory. Thoracic somites indefinite in number, each bearing a pair of biramous (exopodite and endopodite) appendages, each appendage provided with a straight or curiously coiled gill (?). Pygidium segmented, with appendages beneath.

For several years I have maintained that the Trilobites had but the most distant affinities with the Xiphosures (e. g., '85, p. 555).

---

[5] This term was introduced by Packard ('79) for Limulus, the Trilobites and the Eurypterids. Later ('86), with no apparent reason, he dropped this term and substituted for it Podostomata. The two groups, as he limits them, are exactly the same.

In my latest paper ('93, pp. 252–254) I repeated the same ideas, and, within a short time of this paper, appeared Mr. Matthew's notice ('93) of the existence of true Crustacean antennæ in these forms. This, combined with the truly Crustacean thoracic appendages already described by Wolcott ('81 and' 84), and the utter inability, upon careful analysis, to homologise the regions in Limulus and the Trilobites, is sufficient to divorce the two and to assign the latter to the Crustacea.

Exactly what position they should occupy here is uncertain. It is undeniable that they present a superficial resemblance to the Isopoda. In both there is the same depressed body, the division of this into the three regions of head, thorax and abdomen, the head in both cases bearing sessile compound eyes; but at this point the resemblance ceases. In the Isopod the thorax is always 7-jointed; in the the Trilobites the number varies very considerably. In the Trilobites the appendages, as restored by Walcott, surround the mouth, much as in Limulus or the Scorpions; in the Isopods the arrangement is truly Crustacean. In the Isopods, in the embryo, as well as in the adult, the thoracic appendages consist of but a single branch, and when any other structures are present, as for instance, the plates forming the brood-pouch, these are placed mediad to the insertion of the limb; the gills (?) in the Trilobites are outside the point of articulation, while the limbs, as already stated, are dichotomously branched. In the Isopods the respiratory organs are lamellar appendicular plates beneath the abdomen; we do not know exactly what structures are found here in the Trilobites. Professor Mickleborough ('83) thinks that there are lamellar plates, but Mr. Walcott ('84) studying the same specimens believes that the appendages of this region resemble those of the thorax.[6] So it would appear that the Trilobites have no close affinities with the Isopoda; the resemblances to the Amphipods are even less close. So far as I am aware, there is no recent Crustacean which presents any resemblance to Trilobites closer than those of the Edrophthalmia just discussed, and yet we

---

[6] The process cuts illustrating Mr. Matthew's article gives no intelligible details of the foot structure in Triarthrus.

must consider these forms considerably removed from the primitive Crustacean stock, which, in the opinion of many, was not far removed from the modern Phyllopoda. Both types are well differentiated in the lower Cambrian, and no fossils as yet discovered serve to bridge the gap between the two. Nor does the little known of Trilobitan embryology throw any light upon the question. In some there is an apparent close similarity to the early stages of Limulus, but this may easily be explained upon the general principles of Arthropod growth. Thus, in Sao, as described by Barrande ('52), in which the resemblance to the Xiphosures is most marked, we have but that increase in the number of somites from a posterior budding zone common to most Arthropods, while in Trinucleus (Barrande) there seems to have been an acceleration in the development of cephalic and pygidial regions, and then, later, an increase in the number of thoracic segments in that manner so familiar in the development of the Decapoda. The resemblances to Limulus all lie in the depressed body form and the union of the anterior somites.

(*To be continued.*)

THE RANGE OF CROSSBILLS IN THE OHIO VALLEY WITH NOTES ON THEIR UNUSUAL OCCURRENCE IN SUMMER.

BY A. W. BUTLER.

Loxia curvirostra COMMON CROSSBILL.

In 1838, Dr. Kirtland had not met with the American Crossbill (*Loxia curvirostra minor*) in Ohio or Indiana. Dr. Haymond omitted it from his "Birds of southeastern Indiana" in 1856. Dr. Wheaton reported it from Ohio in the winter of 1859–60. Evidently it was quite well known to Dr. Haymond in 1869. The winter of 1868–9, they were very abundant in the vicinity of Cincinnati (Dury). This was doubtless the case at other places also. The range of the species at this time was supposed to be northern North America, south in the Appalachian Mountains into Pennsylvania, extending in winter, irregularly over much of the United States. A letter from Mr. C. E. Aiken of Salt Lake City, Utah, informs me that this species became very abundant in the city of Chicago in July and August 1869, and remained until late in the fall. They fed greedily upon seeds of sunflowers and were so sluggish that one could approach within a few feet of them, so that they fell an easy prey to boys with catapaults. In the latter part of August of the same year, he found them common in Lake County, Indiana. He also notes that they were not rare the succeeding year in the vicinity of Chicago.

Dr. F. W. Langdon notes the capture of a single specimen from a flock of six or eight at Madisonville, near Cincinnati, Ohio, Nov. 30, 1874.

In the winter of 1874–5, Mr. Eugene P. Bicknell noted these birds were present in the lower Hudson Valley, and in April of the latter year found their nest. In the same article is noticed the occurrence of the species about New York City in late spring and early summer, on Long Island in midsummer, and on the Bermudas from March to May (Bull. Nutt. Orn. Club, Vol. V, pp. 7–11). Mr. E. W. Nelson in his paper on "Birds of northeastern Illinois," read before the Essex Insti-

tute, December 4, 1876, says it was "formerly a common winter resident, now rare." Messrs. Dury and Freeman (Journ. Cin. Soc. Nat. Hist., 1879, p. 4) note its occurrence at Westwood, Ohio, in 1879. Dr. J. M. Wheaton (Bull. Nutt. Orn. Club, 1879, p. 62) gives the following account of the occurrence of the species in Ohio:—"On the 18th of June last, Mr. Charles Hinman killed one of these birds out of a flock of eight or ten which visited the coniferous trees in his garden in this city (Columbus). The specimen which came into my possession by the kindness of Mr. Oliver Davie was a male, not in full plumage. I have since learned that the Red Crossbill has remained during the season in the vicinity of Cleveland in considerable numbers, and is reported to have nested there." In commenting on this note (Ohio Geol. Survey, Vol. IV, Zoology and Botany, p. 317) Dr. Wheaton says:—"I was unable to learn whether its nest had been actually discovered," and adds "It has been known to nest in Indiana within a few years." I regret very much that I have been unable to get any clue whatever to the authority upon which the statement is made. Professor A. J. Cook in writing of the The Birds of Michigan says of the American Crossbill "Occasional in summer." Dr. H. A. Atkins took nests of this species at Locke, July 13. 1880. It had previously been reported as breeding in Minnesota.

In July and August, 1880, they were noted at Rugby, Tenn. (The Oologist, Vol. V, pp. 78–9; Bull. Nutt. Orn. Club, Vol. VI, pp. 56–7). Dr. C. Hart Merriam notes it as an "abundant resident" in the Adirondack Region. He says it is "rather scarce and irregular in summer, but the commonest bird in winter and early spring. Breeds in February and March while the snow is still four or five feet deep on the level and the temperature below zero (Fahr.), Have taken fully fledged young in April" (Bull. Nutt. Orn. Club, Vol. VI, p. 229).

Mr. C. W. Beckham (Birds of Nelson County, Kentucky; Ky. Geol. Surv., p. 24) says:—"A flock of six or eight of these birds appeared here on Nov. 18, 1882, in some pine trees, the first time I had ever observed them. They remained only a

day or two, and none were seen until the 17th of March, following, when I shot eight out of a flock of about twenty in the same place where they had previously been seen. Several flocks were observed about the same time near Bloomfield and Glenville in this county, and excited considerable comment on account of their queer bills. The weather at the time was quite mild, so that their appearance here was probably due to some other cause."

The winter of 1882–3, they were unusually abundant in many localities between the great lakes and the Ohio River.

Professor B. W. Evermann first observed them at Bloomington, Indiana, Feb. 10, 1893. This was the second record for the state. For some time after they were common in Monroe County. March 15, 1883, Mr. E. R. Quick reported having seen a single specimen near Brookville, Indiana. April 2, my attention was attracted to a peculiar crackling sound which came from among the pine trees in my yard at Brookville. Close investigation revealed the fact that the cause was a lot of Crossbills. They were shelling the seeds out of the pine cones, and the breaking of the cones made the sound which attracted my attention. I observed others were upon the ground feeding upon the seeds in the fallen cones. April 3, I saw six more in my yard. April 4, I saw one in a flock of Pine Finches. April 5, Mr. Quick noted one. Of those observed, but one was in the red plumage. Professor B. W. Evermann saw a few at Delphi, Carroll County, Indiana, the middle of March, 1883. At the same place about twelve were seen Dec. 26, 1884. Mr. J. W. Byrkit informs me that they were very abundant at Michigan City, Indiana, in the winter of 1883–4. Miss H. E. Colfax in her report of the birds noted at the lighthouse at the same place, gives it Jan. 16, 1884. In the winter of 1883–4, Professor Evermann reported them very common in Monroe County, Indiana.

The Ornithologist and Oologist, Vol. VIII, p. 68, contains an account by A. H. Helme of their breeding April 10, 1883, near Miller's Point. L. I. Mr. Robert Ridgway (The Auk, Vol. I, p. 292) notes the probable breeding of the Red Crossbill in central Maryland in May, 1884. Mr. F. C. Brown

reported their breeding in eastern Massachusetts in the summer of 1884 (The Auk, Vol. II, p. 105). In the winter of 1884–5, they were tolerably common in Monroe County, Indiana (Blatchley in Hoosier Naturalist, 1886, p. 170). The late Mr. C. H. Bollman noted them "quite common" in the same county through March, April and early May, 1885. He saw them first March 2 and last observed them May 12. Mr. J. W Byrkit informed me that he saw the first Crossbills for the year, March 24, 1885. He adds "I am not quite positive, but I think the Crossbills breed, here (Michigan City) as they make their appearance about this time and leave for the north about the middle of May." Mr. Charles Dury informed me they were abundant at Michigan City, Indiana, one winter, which he thinks was 1885. He also reported Pine Finches and Redpolls from the same locality the same year. Professor B. W. Evermann reported it from Carroll County, Indiana, March 27, 1885. I am indebted to Mr. E. M. Kindle for the information that Mr. Sam. Hunter reported a pair of American Crossbills as having bred at Bloomington, Indiana, in 1885. Mr. Hunter informed him they nested in a pine tree and that the nest was made exclusively of pine burrs. Mr. R. R. Moffitt informs me that Red Crossbills were taken in Tippecanoe County, Indiana, in 1885. He says they nested there. Professor B. W. Evermann noted them at Camden, Indiana, March 27 and April 13, 1885, also a large flock at Burlington, Indiana, April 23, 1885.

Mr. Wm. Brester reported its occurrence in the mountains of western North Carolina in the summer of 1885 (The Auk, Vol. III, p. 107) and says:—"Seen only on the Black Mountains where it was numerous in small flocks throughout the balsam forests above 5,000 feet." At Highlands I was told that it regularly appeared in winter about the outskirts of the town. Mr. Charles W. Richmond (The Auk, Vol. V, p. 22) gives upon the authority of Mr. Hugh M. Smith, the information that an adult male American Crossbill, accompanied by a young bird, was seen May 17, 1885, within the District of Columbia.

Professor L. L. Dyche reports the occurrence, in the winter of 1885–6, of the western Red Crossbill, *Loxia curvirostra stricklandi*, at Lawrence, Emporia, Manhattan and Wakarusa, Kansas. They were first observed Nov. 1, 1885, and were last seen Jan. 26, 1886 (The Auk, Vol. III, pp. 258–261). The following winter I was fortunate in securing through the kindness of Mr. A. O. Garrett, a series of specimens of *Loxia curvirostra minor* from Lawrence, Kansas. March 13 and 14, 1887, he obtained four which he sent me, and later he sent me nine others which were taken March 24 and 25. The meeting of the range of these two forms is of considerable interest.

Professor B. W. Evermann reports a Crossbill species not determined from Bloomington, Indiana, Feb. 23, 1886, and another March 8, 1886. The same authority states the late Mr. C. H. Bollman found a few specimens of the Red Crossbill near Bloomington, Indiana, July 10, 13 and 14, 1886. It was found in the White Mountains, N. H. (The Auk, Vol. IV, p. 105). Mr, George B. Sennett, in the same volume, p. 242, gives an account of finding this species in the mountains on the borders of North Carolina and Tennessee in July and August, 1886. Mr. Arthur T. Wayne, in the same volume pp. 287–289, notes their abundance near Yemassee, S. C., in Nov. and Dec., 1886 and in Jan. and Feb., 1887. He noted them again in the same vicinity Nov. 20, 1887 (The Auk, Vol. V, p. 115), also during Jan., 1888 (Ibid, p. 208). Mr. Frank M. Chapman also reports them from Aiken, S. C., Nov. 12, 1887, (Ibid, p. 324). Mr. G. G. Williamson observed them in Monroe County, Indiana, Jan. 18 and Feb. 6, 1886. Mr. J. G. Parker reports them from Lake County, Indiana, in May, 1887. In fall of 1887, I again observed them at Brookville, Indiana. They came to feed upon the pines in my yard. Oct. 29, several were seen and they last appeared Nov. 19. Professor Walter Faxon and Dr. J. A. Allen give it as common in the White Mountains, N. H., in July, 1874, June, 1885 and June, 1886 (The Auk, Vol. V, p. 152). Dr. J. A. Allen on the next page of the same number of "The Auk" speaks of a pair of American Crossbills taken at Mandeville, La., March 27, 1888. Professor B. W. Evermann found them in Vigo County,

Indiana, in the spring of 1888. They were first seen Feb. 6 and disappeared May 6. Mr. J. O. Snyder found them at Waterloo, Indiana, March 13 and 17, 1888. Mr. H. N. McCoy informed me they were quite common in Wayne County, Indiana, in the early part of 1888. They were last seen April 5. Mr. G. G. Williamson saw six or eight individuals near Muncie, Indiana, April 17, 1888; May 4, he saw three others.

Mr. Otho C. Poling notes their occurrence in Adams County, Ills. He gives no account of their occurrence in summer (The Auk, Vol. VII, p. 239). Mr. John A. Balmer informs me these Crossbills were found in the vicinity of Vincennes, Indiana, in the winter of 1888–9. Mr. J. F. Clearwaters told me of the capture of two of these birds in Putnam County, Indiana, in the winter of 1888. A flock of American Crossbills was seen by Mr. J. O. Snyder at Waterloo, Indiana, April 27, 1889. Mr. Stewart E. White informs me he found them common on Mackinack Island, Michigan, Aug. 3 to Aug. 9, 1889. Mr. H. W. McBride wrote me of taking three specimens at Waterloo, Indiana, April 2, 1890. Feb. 14, 1891. Mr. Stewart E. White saw six at Grand Rapids, Mich. He next noted the species March 16. He says it is quite rare in that vicinity. Mr. J. F. Clearwaters gave me the following account of their occurrence in Putnam County, Indiana. "On July 27, 1891, Jesse Earll was down beside the old mill pond, where we collect all our water birds, and noticed five birds on the ground apparently probing in the mud with their bills. As they rose he shot one which proved to be a male Red Crossbill in breeding plumage. He preserved the skin and still has it. The others were females or young, as he says none of them had any red on them."

Mr. Jonathan Dwight reported the American Crossbill on North Mountain, Penn., in June, 1891 (The Auk, Vol. IX, p. 137). Dr. B. H. Warren in his admirable report on the Birds of Pennsylvania, p. 228, gives it as breeding in the counties of Clinton, Clearfield, Luzerne, Lycoming and Cameron, in that state.

March 1, 1892, Messrs. A. B. Ulrey and E. M. Kindle report seeing six in Monroe County, Indiana. Mr. G. G. Williamson

noted six near Muncie, Indiana, April 16, 1892, and another April 24. Messrs. Charles D. and Lewis A. Test have kindly sent me the following interesting notes from the observations of the spring of 1892. The notes were taken near Lafayette, Indiana, March 8, 1892, they saw the first American Crossbill. They were seen on the following succeeding dates: March 11; April 15, 19, 23 and 30; May 1, 3, 6, 8, 18, 20, 21, 27 and 30; June 2, 6, 22, 23, 27 and 30. The birds were seen in pine trees and also in yards and along the road. Search was made for nests but none were found. I am indebted to Mr. Otto Widmann for some valuable notes relating to the American Crossbill in Missouri last winter and spring and summer (1891-2). He says:—" I never suspected these cone-loving nomads to descend into a country so flat and uninteresting as St. Louis County, Mo., where Nature never rears a cone without the help of the gardener. Thousands of young evergreens, especially Norway Spruces, have been planted during the past decade, but old cone-bearing conifers are few and far between. There are on my place, besides a few Norway Spruces, 18 pine trees about 30 years old. Half of them are Austrian Pines, the rest White and Scotch Pines.

Coniferous trees do not bear fruit every year, but last winter the Austrian pines were full of cones, getting ready to drop the seeds in early spring. Besides the maturing pine seeds, our section had another attraction for erratic fruit-eaters in the orchards. The apple trees had yielded an enormous crop and the demand not being sufficiently great to gather them in time, thousands of apples were still hanging in the trees when the Crossbills appeared on the scene. It was in the orchard that they made their appearance on Nov. 13, the day after the first " blizzard " had visited the upper Missouri Valley. From this day on, the Crossbills remained in the neigborhood until the end of the month, but none were here in December and January, at least I did not notice any until they began to visit my pine trees in February. They were daily visitors all through March and until the 17th of April. From that day until May 8th none were seen, but from the 8th to the 14th they were again daily callers. After this date they were

noticed twice; a party of six on June 5th, and two birds, a male and female, in one of my pine trees on July 21st. I looked for the nest in the tree, but unfortunately it was not there. I think now that I have met with the species on several occasions in former years but did not know them. Frequenters of private gardens, they were only seen when on wing or distant tree tops and evaded identification. With us it is a shy and restless bird, easily alarmed and flying a great distance. Before taking wing and while in the air they are quite noisy with a note closely resembling the parent call of *Progne;* but when feeding in a pine tree the whole troop keeps perfectly silent and nothing is heard but the noise made by breaking the cone scales. When present in May they are also feeding on elms."

Mr. W. S. Blatchley gives me the following notes:—"While sitting on the porch of a farm house in Putnam County, Indiaua, July 11, 1892, I saw a single Crossbill *Loxia curvirostra minor* alight in the top of a pine tree in the yard and begin searching the cones for seeds. I watched it for almost ten minutes and then, that there might be no possibility of mistake in the identification, procured a gun and shot it. It proved to be a young male. On July 15th, another young male, i. e., a male presumably of the previous year's hatching, was secured from the same tree and kept in confinement for several days, but was finally allowed its liberty."

The American Crossbills have, as has been shown, been noted within the region between the great lakes and the Ohio River in the following winters: 1868–9; 1869–70; 1874–5; 1882–3; 1883–4; 1884–5; 1885–6; 1887–8; 1888–9; 1889–90; 1890-91; 1891–2. From 1882 to 1892 they were only absent one year, 1886–7. In the winters of 1882–3; 1884–5; 1887–8, the area of dispersal was wide and the birds seem to have been generally distributed. Other years as 1868–9; 1869–70; 1883–4 they appeared, or at least were observed, in but few localities, but where noted they were abundant.

The results of the inquiries concerning its summer range, particularly with relation to the Ohio Valley and the territory adjacent thereto have been wholly unexpected. Summing

up the occurrences in summer and the evidence of its breeding in the region last referred to we note as follows. In the summer of 1869 they were abundant in the vicinity of Chicago, both in Illinois and Indiana. In the summer of 1878 they were found at Columbus, Ohio, and abundantly at Cleveland where it was reported to have bred. Dr. Wheaton refers to their having nested in Indiana as a fact well known to him. Dr. H. A. Atkins is said to have taken nests of this species near Locke, Michigan, in 1880. The spring of 1885 they were common at Michigan City, Indiana, and Mr. Brykit thought they might have nested. In the summer of 1885 they were reported to have nested in Tippecanoe County, Indiana. The same summer they are reported to have nested at Bloomington, Indiana. They were reported from Monroe County, Indiana, three different dates in July, 1886. They were reported from Putnam County, Indiana, in the summer of 1891–92. They remained throughout a part of the summer of 1892 at Lafayette, Indiana. They remained even later at Old Orchard, Mo., in 1892.

These notes but serve to bring more clearly to mind the peculiar, erratic character of the bird of which we have known, to some degree, before. The notes would also seem to indicate that much of our lack of data is due to the scarcity of observers in years past. A few years ago the collection of data regarding almost any species of bird from Indiana, or almost any other state, would have been impossible. It is not improbable, could we begin with the abundance of Crossbills at Cincinnati in 1868–9, with a number of intelligent observers equal to that available now, we could have a collection of observations covering its whole range between the Ohio River and the lakes and perhaps including its movements for almost every year. These blank years do not necessarily signify that it was wanting in the territory studied, but that for some one of a great many reasons, it was not observed. The erratic distribution of the species applies as well to its summer range as to that in winter. It seems very probable that the species breeds to some extent throughout the Ohio Valley. It is true that no specimens representing either the nest or eggs have

been, so far as I know, preserved. Yet the evidence presented indicates that the breeding range of the species in the United States is not confined to the coniferous forests of the mountain ranges.

Loxia leucoptera, WHITE-WINGED CROSSBILL.

This species is not met with in the Ohio Valley so often as the last mentioned form. Its range lies farther to the northward. Its distribution within the United States, both in winter and summer is much less extensive than is that of the American Crossbill. Audubon mentions its breeding in Pennsylvania in summer, but this is probably an exceptional case. Dr. J. M. Wheaton gave it in his catalogue of Birds of Ohio in 1861. Mr. Charles Dury found them abundant in the vicinity of Cincinnati, Ohio, in the winter of 1868–9, in company with the last mentioned species. He says "they were in large flocks containing both species in the proportion of two of the former to one of the latter" (the present), "species." Mr. C. E. Aiken informs me that this species was in company with the American Crossbill when they were so common in the vicinity of Chicago in the summer of 1869. He also noted them in Lake County, Indiana, the latter part of August of that year. He says they displayed the same habits as the preceeding species. His recollection is that the white-winged forms was less abundant, a little later in their arrival, and more wary. They remained through the winter. Professor A. J. Cook informs me that one was killed by Dr. A. H. Atkins at Locke, Michigan, Aug. 9, 1875. A pair of white-winged Crossbills were taken at Fort Wayne, Indiana, about 1878. The female is now in the collection of Mr. C. A. Stockbridge of that city.

Mr. W. L. Scott notes the occurrence of a flock of white-winged Crossbills near Ottawa, Canada, toward the latter part of June 1882 (The Auk, Vol. I, p. 159). Mr. Fletcher M. Noe notes the occurrence of this species near Indianapolis, Indiana, in the early part of 1883. Feb. 6, 1883. Professor B. W. Evermann shot two males from a flock of fifteen of these birds in a yard at Bloomington, Indiana. Feb. 10, he secured a

female and, a few days later, two other specimens near the same place. Miss H. E. Colfax reports it from Michigan City, Indiana. June 26, 1884, Mr. J. W. Byrkit found both species together in large flocks near Michigan City, Indiana, the winter of 1883–4. Mr. Charles Dury reports it from Michigan City, Indiana, he thinks in 1885. Faxon and Allen report seeing a few in the White Mountains, N. H., June, 1886. (The Auk, Vol. V, p. 152). Hon. R. Wes McBride has noted it as a winter visitor in De Kalb County, Indiana, Dr. C. Hart Merriam gives it as a resident in the Adirondack region but adds, comparing it with the American Crossbill, "not nearly so common as the last." (Bull. Nutt. Orn. Club, Vol. VI, p. 229). Professor B. W. Evermann informs me that he saw one in the spring of 1886 in his brother's yard at Burlington, Indiana. He says "after watching it for awhile I struck it with a stick, killing it." March 16, he saw another specimen of this species at Camden, Indiana.

The only instance I know of its occurring in the Ohio Valley in summer, is that given by the late Mr. C. H. Bollman. He wrote me that he saw eleven on a fir tree in Bloomington, Indiana, June 24, 1886. A few days later he several times noted specimens of the other species.

Everywhere in the Ohio Valley this species seems to be quite rare and exceedingly irregular in its occurrence. Mr. E. W. Nelson and Mr. Otho Poling note it as much less common in Illinois than formerly. With the exception of the winter of 1868–9 and the succeeding summer, I do not know of its having appeared in any considerable numbers in any of the tier of states just north of the Ohio River.

RECENT BOOKS AND PAMPHLETS.

Administrative Report of the Government Central Museum of Madras for the year 1892–93.

Barus, C.—The Compressibility of Liquids. Bull. U. S. Geol. Surv. No. 92. Washington, 1892.

——The Mechanism of Solid Viscosity. Bull. U. S. Geol. Surv. No. 94. Washington, 1892. From the U. S. Geol. Surv.

——The volume Thermodynamics of liquids. Bull. U. S. Geol. Surv. No. 96. Washington, 1892. From the U. S. Geol. Surv.

Boule, M.—L'homme paléolithique dans l'Amerique du Nord.——Une excursion géologique dans les montagnes rocheuses. Extr.

Brigham, A. P.—The Finger Lakes of New York. Extr. Bull. Amer. Geog. Soc., Vol. XXV, 1893. From the author.

Bulletin No. 3, 1893, Agricultural Exp. Station College of Agriculture, University of Idaho. Application of Chemistry to the Agricultural Development of Idaho.

Bulletin 23, 1893, Agri. Exp. Station of the Rhode Island College of Agriculture and Mechanic Arts. Fertilizers.

Bulletin No. 25, Agri. Exp. Station of the Rhode Island Coll. Agri. and Mechanic Arts. Sept., 1893.

Carter, O. C. S.—Artesian Wells. Extr. Proceeds. Franklin Inst., Sept., 1893.

——Artesian Well in Lowest Trias at Norristown. Extr. Proceeds. Am. Philos. Soc., Vol. XXIX, 1891. From the author.

——Catalog of A. S. A. Library, shown at the World's Columbian Exposition. Washington, 1893. From the Bureau of Education.

Clark, F. W.—Report of work done in the division of Chemistry and Physics, mainly during the fiscal year 1890–91. Bull. No. 90, U. S. Geol. Surv. Washington, 1892. From the U. S. Geol. Surv.

Clark, W. B.—Correlation Papers—Eocene. Bull. U. S. Geol. Surv. No. 83. Washington, 1891. From the U. S. Geol. Surv.

Contributions from the Zoological Laboratory of the University of Pennsylvania, Vol. I, No. I, 1893, From the University.

Cook, A. J.—Birds of Michigan. Bull. 94, 1893, Agri. Exp. Station, Mich. State Agri. College. From the author.

Cragin, F. W.—A Contribution to the Intevrebrate Paleontology of the Texas Cretaceous. Extr. Fourth Annual Rept. Geol. Surv. Texas, 1892. From the Survey.

Dall, W. H., and **Harris, G. D.**—Correlation Papers. Neocene, Bull. U. S. Geol. Surv. No. 84. Washington, 1892. From the U. S. Geol. Surv.

Dall, W. H.—A Subtropical Miocene Fauna in Arctic Siberia. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

Darton, N. H.—Record of North American Geology for 1890. Bull. U. S. Geol. Surv. No. 91. Washington, 1891. From the U. S. Geol. Surv.

Eigenmann, C. H.—On the Occurrence of the Spiny Box Fish (Genus Chilomyc-

terus) on the coast of California. Extr. Proceeds. U. S. Natl. Mus., Vol. XV, 1892. From the Smithsonian Institution.

Fisher, W. H.—Investigations of the Burrows of the American Marmot (*Arctomys monax*). Extr. Journ. Cin. Soc. Nat. Hist., 1893. From the author.

Fontaine, W. M.—Description of some Fossil Plants from the Great Falls Coal Field of Montana. Extr. Proceeds. U. S. Natl. Mus., Vol. XV, 1892. From the Smithsonian Institution.

Hay, W. P.—Observations on the Blind Cray Fishes of Indiana with a description of a new subspecies, *Cambarus pellucidus testii*. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

Holden, E. S.—Earthquakes in California in 1890 and 1891. Bull. U. S. Geol. Surv. No. 95. Washington, 1892. From the U. S. Geol. Surv.

Hollick, A.—Plant Distribution as a Factor in the Interpretation of Geological, Phenomena, with special reference to Long Island and vicinity.——Preliminary Contribution to our Knowledge of the Cretaceous Formation on Long Island and Eastward. Extr. Trans. New York Acad. Sciences, Vol. XII, 1893. From the author.

Jordan, D. S.—A Description of the Golden Trout of Kern River, California, *Salmo mykiss agua-bonita*. Extr. Proceeds. U. S. Natl. Mus., Vol. XV, 1892. From the author.

Kennedy, W.—Report on Grimes, Brazos, and Robertson Counties, Extr. Fourth Ann. Rept. Tex. Geol. Surv. for 1892. From the Survey.

Knowlton, E. H.—Notes on a few Fossils Plants from the Ft. Union Group of Montana, with a description of one new species. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

McMurrich, J. P.—Report on the Actiniæ collected by the U. S. Fish Com. Steamer Albatross during the winter of 1887–1888. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

Morgan, T. H.—Experimental Studies on Teleost Eggs. Extr. Anat. Anz. Jena 1893. From the author.

Pavlow, M.—Note sur un Nouveau Crâne d'Amynodon. Extr. Bull. de Moscou, 1893. From the author.

Ridgway, R.—Description of a supposed new species of Odontophorus from southern Mexico. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the author.

Rose, **Dr.** C.—Ueber das Jacobson Organ von Wombat und Opossum.——Ueber die Nasendrüse und die Gaumendrüsen von *Crocodilus porosus*. Abdruck aus Anat. Anz., Jena, 1893. From the author.

Salisbury, R. D.—Surface Geology of New Jersey. Report of Progress. Extr. Ann. Rept. State Geol. for 1892. From the author.

Scudder, S. H.—Some Insects of special interest from Florissant, Colorado and other points in the Tertiaries of Colorado and Utah. Bull. of the U. S. Geol. Surv. No. 93. Washington, 1892. From the U. S. Geol. Surv.

Shufeldt, W.—On the Mechanism of the upper Mandible in the Scolopacidæ. Extr. Ibis, Oct., 1893. From the author.

Stearns, R. E. C.—Preliminary Report on the Molluscan species collected by the U. S. Scientific Expedition to West Africa in 1889–90.——On rare or little known Mollusks from the west coast of North and South America, with descriptions of new

species.——Report on the Mollusk Fauna of the Galapagos Islands, with descriptions of new species.——Report on the Pteropods and Heteropods collected by the U. S. Steamer Albatross during the voyage from Norfolk, Va., o San Francisco, Cal., 1887–'88. Extrs. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

TAFF, J. A.—Report on the Cretaceaus area north of the Colorado River. Extr. Fourth Annual Rept. Tex. Geol. Surv. for 1892. From the Survey.

WELCH, G. T.—Therapeutical Superstition. Extr. Trans. N. J. Med. Soc., 1893. From the author.

WHITE, C. A.—Correlation Papers.—Cretaceous. Bull. U. S. Geol. Surv. No. 82. Washington, 1891. From the U. S. Geol. Survey.

WHITFIELD, R. P.—Gasteropoda and Cephalopoda of the Raritan Clays and Greensand Marls of New Jersey. Trenton, 1892. From the New Jersey Geol. Survey.

——Gasteropoda and Cephalopoda of the Raritan Clays and Greensand Marls of New Jersey. Monograph of the U. S. Geol. Surv., Vol. XVIII. Washington, 1892. From the U. S. Geol. Survey.

WOLTERSTORFF, W.—Die Reptilien und Amphiben der Nordwestdeutschen Berglande. Magdeburg, 1893. From Herr Wolterstorff.

RECENT LITERATURE.

Zirkel's New Text Book of Petrography.[1]—Although entitled a 'Lehrbuch' the revision of Prof. Zirkel's well known Petrography has rather the character of a 'Handbuch.' The first of the three volumes proposed to complete the work contains an introduction to the study of rocks, a description of the methods made use of in this study, an account of the peculiarities of form presented by rock-forming minerals, a review of the characteristics of each of the most important of these, a discussion of rock structure and the causes of its variation, a statement of the method of occurrence of rock masses, a chapter in the physical properties of rocks and one on the changes which they undergo when subjected to external influences. Following these, which occupy in all 635 closely printed pages, there are some 190 pages in the mineral, chemical and structural relations of massive rocks, and a very full discussion of the theories proposed to explain the origin of the variations observed in rock masses, and in the different emanations from the same volcanic centre, which concludes with the scheme of classification for massive rocks that the author intends to follow in the succeeding volume.

As the synopsis of the contents shows Prof. Zirkel expects to cover the entire field of petrography in a way that has never been attempted hitherto. He will treat not only of the massive rocks, but of the sediments and crystalline schists as well. The first volume gives no evidence as to the fullness with which the individual rock types will be discussed, but it is quite certain that the three volumes will fill a place that has long been ready for them in the working room of every petrographer.

The special excellencies of the volume before us consist in the very complete bibliographies appended to or inserted within the paragraphs pertaining to different heads, the thoroughness with which the field has been covered by it, and the freshness of the material between its covers. Of course the second edition is not a revision of the author's first edition of the Lehrbuch. It is an entirely new book, rewritten from 'preface to finis.' And more than this—it contains references to the very latest petrographical researches published in this country as

---

[1] Lehrbuch der Petrographie by Dr. Ferdinand Zirkel. 2te Aufl., Erster Band, Leipzig, Wilhelm Engelmann, 1893. Pp. x and 845.

well as in Europe. The faults of the book are such only when it is criticized as a Lehrbuch. As a manual it is very satisfactory, though one would wish that the author had made his list of rock-forming minerals more complete than it is, and had given more detailed instructions as to the manipulations in some of the investigation methods mentioned. Upon comparison with Rosenbucsh's first volume it is found that this treats of forty-four more minerals than does Zirkel's book, but then the Heidelberg volume deals only with microscopical petrography. Further, the absence of illustrations from the Lehrbuch will prevent its use as a text book for students, and the failure to attempt an explanation of the action of mineral plates toward polarized light will in large measure keep it from even our universities and technical schools. But these faults, we repeat, are faults in a text book. They are not altogether weaknesses in a hand-book. Zirkel will become the reference book of petrographers, while Rosenbucsh will remain their text book.

In that portion of the volume occupied with the special discussion of massive rocks, the author outlines his classification and gives his reasons for it. He declines to recognize the dyke rocks as a well established class, and so makes his division (according to structure and mineralogical composition) into granular and porphyritic groups, and then into types. In the first group, age distributions are disregarded. In the second group the old distinction between pre-tertiary and tertiary volcanics is revived. Petrography is regarded as primarily as a study of rock bodies, and secondarily as a branch of geology.

The lack of illustrations which has already been noted will not detract seriously from the value of the volume as a reference book, as the author has no new structures to define and no new rock-types to establish. He gives an excellent resumé of petrographical literature and there stops. He has no theories to advance and no attacks to his brother investigators, except now and then, a mild one upon Rosenbusch, and his discussions upon the literature are uncolored by his own views. Now and then a criticism is interjected into the discussion, but upon the whole the author allows the conclusions reached in the articles cited to stand unchallenged, or if they are challenged it is by the citation of other authors. In brief the Lehrbuch is an excellent résumé of our present knowledge of rocks and a fine reference book to petrographical literature. Naturally more interest will be felt in the two volumes to appear, than in the first volume, for at least one of these will afford a starting point for a systematic petrographical study of the crystalline schists. W. S. B.

Zimmermann's Botanical Microtechnique.[1]—In bringing out so promptly an English translation of this useful work, the German edition of which reached American workers a little more than a year ago, both translator and publisher have rendered a good service to the laboratory botany of the country. The original was so well received, and had proved itself to be so useful in the laboratory, that this neatly printed and bound volume must at once find wide and general use. The beginner will find here a work which he may follow implicitly without fearing that he will laboriously learn some method, only to find a little later that it is an antiquated or discarded one.

In order to give those who have not seen the original an idea of the scope of the work we reproduce the contents of Part I.

General Methods.

1. The Observation of Living Plants and Tissues.
2. The Investigation of Dead Plants.
3. Maceration.
4. Swelling.
5. Clearing.
   A. Chemical Clearing Methods.
   B. Physical Clearing Methods.
      I. The Ordinary Method of Transfer from Water to Canada Balsam.
      II. The Transfer from Water to Canada Balsam without Alcohol.
      III. The use of other Strongly Refractive Mounting Media.
6. Live Staining.
7. Fixing and Staining Methods.
   A. Fixing. B. Removal of Fixing Fluids. C. Staining.
   D. Fixing and Staining Microscopically small Objects.
8. Microtome Technique.
   I. Imbedding in Paraffine. II. Imbedding in Celloidin. III. The Attachments of Sections.
9. Making Permanent Preparations.

From the foregoing it will be seen that every point under the head of general laboratory methods is taken up, and an examination of the paragraphs shows the thoroughness of the work. The illustrations of which there are many, add much to the usefulness of the work.

---

[1] Botanica Microtechnique. A handbook of methods, for the preparation, staining and microscopical investigation of vegetable structures by Dr. A. Zimmermann, Privat-Docent in the University of Tübingen. Translated from the German by James Ellis Humphrey, S. D. New York, Henry Holt and Company, 1893, pp. XII, 296.

Dr. Humphrey has added here and there many valuable notes, and at the end has added six pages of useful "Tables for Reference." The literature of the subject is given with such completeness thas it requires nineteen pages. A full index with from 1200 to 1500 references completes this most satisfactory book.

CHARLES E. BESSEY.

The Letters of Asa Gray.[1]—It is rarely the case that a life is more justly and clearly set forth in a biological writing than is the life of the eminent botanist Asa Gray, in those two volumes prepared by Mrs. Gray. With rare good taste and admirable tact she has woven from the brief autobiography and the letters scattered through fifty-six years the charming story of his life. We can all wish for a such hand to set forth our life-work, when we have passed away.

The quaintly written autobiography tells of his early life, and of his struggles to reach some position in which he might do the work Nature had fitted him to do. There were many disappointments; many plans were made only to be overthrown or abandoned. At last came the appointment to the chair of Natural History in the newly chartered University of Michigan, and the year's leave of absence and commission to purchase books for its library. How well he used that year in Europe is told in the enthusiastic letters he wrote home to Dr. and Mrs. Torrey and "the girls." Thenceforward his life-work was assurred, and upon his return he took up with vigor the work on the Flora of North America with Dr. Torrey, a work which he left unfinished after forty-eight years of continuous work.

It is impossible to give an adequate idea of these books in a brief notice. These extracts from letters more than fifty years apart may be suggestive. To his mother he wrote from New York in February, 1835, "I wish very much to spend a few weeks Georgia early in the spring, but I see that I shall not be able to do so. My time is spent here very profitably, and I am advancing in knowledge as fast as I ought to wish, but I make no money, or scarcely enough to live upon. Just at present I am rather behind hand, but think that by next fall I shall with ordinary success be in better circumstances. It is unpleasant to be embarrassed in such matters, for I should like much to be independent, and this with my moderate wishes would require no very large sum, and I have no great desire to be rich."

---

[1] *Letters of Asa Gray.* Edited by Jane Loring Gray, in two volumes.. Boston and New York, Houghton, Mifflin and Company. The Riverside Press, Cambridge, 1893, 12 mo., 838 pp.

Contrast the foregoing with the following written from Kew, April, 1887, to De Candolle.

"You will be a little surprised at the sudden transfer of Mrs. Gray and myself to England, but I wanted a vacation and one more bit of pleasant travel with Mrs. Gray while we are both alive and capable of enjoying it. Whether I shall look in upon you at Geneva is doubtful, but it may be even for a moment. We never expect to have repeated the pleasant work at Geneva of the spring of 1881. We expect to go to Paris in May, but subsequent movements are uncertain. Always dear De Candolle, affectionately yours."

These volumes will always be interesting to American botanists, especially to those who enjoyed Dr. Gray's personal acquaintance.

CHARLES E. BESSEY.

A Theory of Development and Heredity.[4]—This volume recently issued by the Macmillans with the above title will no doubt find a good many readers. It is a book that deserves perusal, in that it presents with clearness the main issues that are how agitating biologists, though the bias of the author is decidedly Lamarckian. In fact, it is probably the strongest popular contribution to the Lamarckian side of the controversy that has yet appeared. The author states that in the first place the work is an effort to extend the application of the law of the conservation of energy to the phenomena of living matter, and to resolve the premises given by the science of physics to their conclusion in the realm of biology. How far he has succeeded may be open to question, but his array of facts in support of his views is certainly very creditable. Many of these facts have been known for a good while to biologists, but the author of the volume has brought them into their proper collocation in respect to each other and has made out a very strong argument in support of his position. In the second place, to use his own words, "it is the extension to all living matter of certain fundamental properties of life which psychology has either proved or tacitly assumed to exist in the higher animals." He here refers to the effects of repetition and association operating through a coördinating nervous mechanism or system. His view of organic evolution, is that it is a mechanico-psychological process. In this respect his views are closely similar to those of Cope published long since in a collected form—Cope's view is that consciousness is to be regarded as an important factor in evolution, just how it operates is

---

[4] A Theory of Development and Heredity, by Henry B. Orr, Ph. D. Macmillan & Co., London & New York, 1893, crown 80, pp. ix and 255.

not so definitely stated as by Orr, who finds in the nervous system the coördinating mechanism through which consciousness manifests itself, but under the domination of the laws of the conservation of energy.

The author does not claim to have made any new discovery, but only to have brought known facts into new relations. There is however, a lamentable defect palpable throughout the book in respect to the citation of authorities. In some cases, in which our author is not alone, he entirely forgets to cite those who have published similar views long before the appearance of his work. The suggestion that all biological phenomena must be interpreted in terms of the theory of the conservation of energy was a thesis defended in several papers published by the present reviewer during the last five years. In his argument in support of the first view that energy must be considered first of all, the author also fails to appreciate the great complexity of the mechanism represented by the cell, nor does he seem to have made himself familiar with the very important and pregnant results of Quincke, Bütschli, Berthold, Dreyer and others. In another place a discovery is mentioned that is undoubtedly to be the first of all accredited to Prof. Alpheus Hyatt, instead of to Wurtenberg, namely, that evolutionary changes in the Ammonites first show themselves on the outer or last whorl of the shells of these organisms. No credit is allowed. Prof. Eimer on p. 63, where in a few sentences some of the most important results of that ingenious writer are epitomized in regard to growth itself as a factor in organic evolution. In the chapter on the origin of variations, there is some very crude speculation, that will hardly bear critical examination, and in one place the author shows that he is altogether unfamiliar with Fick's very important and interesting experiments bearing on the origin of joints and the forms of articular surfaces. *Actinosphærium* is misspelled "*Actinosphæra,*" and a *cellular* structure is ascribed to this protozoan, and the author also falls into a teleological trap when he asserts that the vesicles and their walls "cellular spaces" in this organism are for the purpose of giving it permanence of figure and support. On page 49, it is stated that "pigment is caused by light acting upon the tissues and where there is no light there can be no pigment." To this it might be replied, how about the black pigment of the *substantia nigra* of the human brain ; that is certainly shut out from the light in the centre of the head? With certain reservations it is however, certainly true that pigmentation is associated with the influence of light as the experiments of Cunningham and Schiedt on widely diverse forms have proved. The direct and interesting correlation between coloration and

latitude, first noticed by the late Prof. Baird to hold of closely allied species or of individuals of the same species from different latitudes is not mentioned by the author. The principle of acceleration and retardation, first strongly put forward as early as 1869 by Prof. Cope is also not mentioned, though partly involved in Weismann's quoted statement of the laws governing the ontogenetic appearance of characters given on p. 141.

This failure to render credit where a citation by title would have answered the purpose, is all the more evident by reason of the way in which American naturalists generally have been ignored, as is shown by the details given above, but to which much might be added. The introductory chapters are very suggestive, however, and bring in certain physical evidence in a new way. Especially suggestive is the theory of after-effects here foreshadowed, and which is especially well supported by facts cited from Detmer in Chapter IV. The fallacious arguments of the ultra-selectionists in regard to the origin of blind cave forms, are ingeniously answered in Chapter XII. The results of Stahl and Frank in changing the structure of plants by charging their environmental relations are epitomized, as well as Born's and Yung's experiments in determining the sex and growth of tadpoles by means of the food are briefly detailed and used as evidence. No reference is made to the experiments of Mrs. Treat or of Mr. Gentry in this connection.

To sum up the book is well worth careful perusal, and is to be commended to students of the present activity amongst naturalists in regard to the problems of heredity. Dr. Orr's book, on the whole, presents the Lamarckian side of the argument with unusual fairness and completeness. The book would be greatly improved by the addition of a full index which it is to be hoped may be supplied in a future edition. This book is also an indication of the tendencies of the times, namely, of an effort to trace all phenomena including those of life to their physical sources. That such end will some day be achieved there can scarcely be any doubt, since experimental endeavor is now busy with the work of imitating the phenomena of life by artificial and experimental means, such for example, as the production of artificial amœbæ.—R.

The Wilder Quarter-Century Book.[5]—This volume is a col-

---

[5] The Wilder Quarter-Century Book. A Collection of Original Papers dedicated to Prof. Burt G. Wilder at the close of his twenty-fifth year of service in Cornell University (1868–1893). By some of his former students, Ithaca, N. Y., 1893.

lection of scientific memoirs published by some of Prof. Burt Wilder's former students, to commemorate the twenty-fifth anniversary of his connection with Cornell University. These essays deal with a wide range of subjects, but are mainly in the line of evolutionary thought. Among the contributors are artists, instructors, physicians, officers in government departments, professors in medical colleges and in universities, and a university president. The papers are prefaced by a list of the more important scientific publications of Prof. Wilder, and a brief sketch of his work at Cornell University, including a table of the number of students personally taught by him during each college year from the beginning of the University (1868) to the twenty-fifth commencement, (1893).

The illustrations comprise an excellent portrait (Japan proof), 26 plates, and 36 figures in the text.

The book embraces many papers which contain the results of original scientific research by their authors. The whole constitutes a permanent monument not only to man whom it was assigned thus to honor, but to Cornell University, and to the devotion of the contributors to the true spirit of science.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Geological Structure of the Mount Washington Mass of the Taconic Range.—The recent studies of Mr. Wm. H. Hobbs have disclosed new facts with regard to the Mount Washington Mass and the conclusions that the author draws from the data now known differ somewhat from those reached by Mr. Dana regarding the structure of Mt. Washington.

Mr. Hobbs' paper is prefaced by the following brief account of the topography of the region in question:

"That portion of the Taconic Range which is known as Mount Washington is both topographically and geologically a unit. It covers an elongated elliptical area, about fifteen miles in length and four and one-half miles average breadth, lying in the states of Massachusetts. Connecticut and New York. It occupies the entire township of Mt. Washington and portions of Sheffield and Egremont in Massachusetts; about one-third of Salisbury in Connecticut; and portions of Northeast Ancram, Copake and Hillsdale in New York.

The Mt. Washington mass is a double ridge enclosing a summit plain. Mt. Everett, or the "Dome of the Taconics" (2624 ft.), lying in the eastern ridge, is the highest peak and one of the highest elevations in Massachusetts, while the Bear Mountain (2355 ft.) is the highest point of land in the state of Connecticut. The main summit plain is situated to the northward centre of the mass and has an average altitude of about 1700 feet. Corresponding with the elliptical outline of the mountain, this plain is compressed at the north and south, so that its length is about three miles and its breadth two miles. Encircling it is a line of peaks ranging from 1900 to 2600 feet in height. This encircling wall of peaks is buttressed by other peaks both to the northward and to the southward, the southern side being strengthened, by a parallel belt across the mountain, composed of Mts. Bear, Gridley, Frissell and Monument. Southward of this belt of hills the elevated plateau recurs, but without the rampart of peaks which characterize it in the northern and more central area.

"The Salisbury-Sheffield valley on the east and the Copake-Hillsdale valley on the west of the mass, constitute a floor having an average altitude of 700 feet, from which Mt. Washington rises abruptly,

the mean slope-angle being 20°. The southern boundary of the mountain is the nearly east and west valley through which runs the Central New England and Western Railroad. On the northwest Mt. Washington is merged into the narrow ridge of the Taconics, which extends northward into Vermont. The name, Mt. Washington, however, applies properly to all of the range lying south of the South Egremont-Hillsdale turnpike. The regular elliptical contour of the mass is broken on the northeast by two deep embayments, the eastern one containing Fenton Brook, and the western, which is knee-shaped, being occupied by Sky Farm Brook. The regularity of contour is further interrupted by an outjutting spur on the west side, known as Cook's Hill. South of the topographical break which limits the mountain in the neighborhood of Ore Hill, the range of the Taconics pursues a more interrupted course, the hills becoming smaller and spreading out considerably."

In the account of his investigations the author states that a microscopic examination of thin sections of rocks from Mt. Washington shows clearly that they are strongly metamorphosed clastics. Evidence has been deduced from the secondary growths of feldspars, garnets and tourmalines, as well as from the relations of the different metamorphic minerals to one another, to show that the orographic forces to which these minerals owe their development, operated in several more or less distinct periods.

What is set forth in the paper agrees with Professor Dana's views so far as the northern portion of the area is concerned. It is in regard to the southern and central portions that different views are entertained. Mr. Hobbs attributes this difference, not to errors in Professor Dana's observations, for in the main they have been confirmed, but to the collection of a larger number of observations and to the application of some structural principles which were not made use of by Professor Dana.

In conclusion Mr. Hobbs gives the following summary of the results discussed in the paper:

"The Mt. Washington series consists of four members which, in order of age are as follows: (1) Canaan Dolomite, (2) Riga Schist, (3) Egremont Limestone, and (4) Everett Schist. A somewhat striking lithological distinction is found to separate the two schist horizons, the Everett shist being entirely free from garnet and staurolite, while the Riga shist usually (not always) contains macroscopic crystals of one or both. The older rocks are found in the southern portion of the area, a general northerly pitch carrying them successively below the

surface as we proceed northward, until at the north end of the mountain we find the upper two members of the series only.

"The structure of the mass may be summarized by stating that the beds have been thrown into corrugated folds which seem to have moderate, tolerably symmetrical corrugations at the south end of the mountain, but these corrugations deepen and become frequently overturned as we proceed northward. In the eastern portion of the area the axes of the reversed folds is generally westward. At the extreme south, the structure is a geo-anticlinal, but this develops in the central and northern parts of the area into a geo-synclinal owing to the continual disproportionate deepening and widening of one of its minor western corrugations. The general pitch of the beds is north. A less important southerly pitch which characterizes the northern portion of the area, in combination with the general synclinical structure in cross sections, gives to all the mountain except its extreme southern portion a basin-like character. The rocks are throughout strongly metamorphosed clastics, the orographic disturbances to which they owe their marked crystalline character and porphyritic crystals having operated in several distinct periods. The Egremont Limestone shows a marked diminution in thickness as we proceed southward in the area until it almost disappears. Throughout the mountain plain it is greatly modified, being either a micaceous limestone or calcareous mica schist, or a graphitic schist. The graphitic rock is most developed near the schist contacts and in the southern portion is the only representative of the limestone (Journ. Geol., Vol. I, 1893).

Origin of the Pennsylvania Anthracite.—In a recent Bulletin of the Geological Society of America (Nov. 1893) Mr. J. J. Stevenson discusses the origin of the anthracite coal of Peensylvania. After stating the hypotheses that been advanced by Rogers, Owens, Murchison and Lesley, to account for the variation in the volatile combustibles in Pennsylvania coals, and pointing out objections to each in turn, the author offers one of his own, giving the facts upon which it is based. He conceives the coal-measures marsh to have had its origin to the east, and that it extended seaward after each period of accelerated subsidence, so forming a new coal bed. One should find, according to this hypothesis, a greater mass of coal in the northeastern portion of the Appalachian basin than in any other part, and also a greater degree of conversion. Observation has shown that this is the case. There is also a direct relation between the increasing thickness of coal and the decreasing volatile in Pennsylvania. This fact is demonstrated by Mr.

Stevenson in a table of ratios, the result of analyses made by Mr. A. S. McCreath.

In origin then, according to Mr. Stevenson, the anthracite of Pennsylvania differs in nowise from the bituminous coal of the Appalachian basin, but is the result of a longer exposure to the process of making.

Cretaceous System in Canada.—In a Presidental Address before the Roy. Can. Soc., Mr. Whiteaves gave a resumé of the present knowledge of the Cretaceous system in Canada. For convenience, he divides the system into Upper and Lower with the base of the Dakota group as a boundary line. In Manitoba and the Northwest Territories all the Cretaceous rocks as yet examined are referable to the upper division and are subdivided into 5 formations, viz.: Laramie, Montana, Belly River, Niobrara—Benton and Dakota. Of the Rocky Mountain region, inclusive of the Foot-Hills, the author states "that from the combined evidence afforded by the fossil flora and fauna of the Cretaceous rocks of this region it would appear that the Laramie, the Montana, the Niobrara-Benton and perhaps also the Dakota are there represented. The Kootanie series, and the Devil's Lake deposits are older than the Dakota formation and hence referable to the Lower North American Cretaceous." In British Columbia and the Yukon district, although the Cretaceous rocks have been studied and reported upon since 1871, the subdivisions have not yet been satisfactorily correlated with those of Manitoba.

In conclusion the author gives a tabular statement, showing the important additions that have been made to our knowledge of the Canadian Cretacic system since the confederation of the provinces in 1867. Prior to that time but little had been done; to-day, 108 species of fossil plants and 358 fossil animals have been recorded and described, exclusive of the Laramie, or 179 species of plants and 394 animals, inclusive of the Laramie (Trans. Roy. Soc. Can., Sect. IV, 1893).

Evidences of a Submergence of Western Europe at the close of the Glacial Period.—For a number of years Professor Joseph Prestwich has been investigating a peculiar superficial drift found in the south of England and extending over large continental areas. For this drift he proposes the name, Rubble-drift, to distinguish it from the valley, marine and glacial drift of the same regions. It includes a peculiar débris in Loess, the Breccia on slopes, the "Head" over the Raised Beaches, the Basement gravels of many valleys and the Ossiferous fissures. This drift is characterized by (1)

being composed of material of local origin, (2) a complete absence of that wear which results from maintained river, sea or ice action, (3) organic remains which are those of a land fauna alone, (4) by bone fragments free from all marks of gnawing. In order to account for these conditions as well as for the mode of distribution of the rubble, which appears to be from many independent centres, Mr. Prestwich offers the following theory. The Rubble drift is the result of the submergence and re-elevation of a land surface from beneath deep waters after a temporary submergence.

According to the author, this submergence occurred at the close of the Glacial, or so-called Post-glacial period, and immediately preceding the Neolithic or recent period. The submergence affected western Europe and the Mediteranean coasts decreasing eastward. The Rubble-drift and osseous breccia are but slightly developed in Syria. In regard to the north coast of Africa, Mr. Prestwich doubts if the submergence extended beyond the Lybian desert, as there is no well defined proof of it in Egypt.

The significance of the Rubble-drift has an important bearing upon an estimate of the lapse of time since the close of the Glacial period. Mr. Prestwich calls attention to this in his closing remarks, citing evidence to show that Mr. Croll's reckoning of 80,000 years is not supported by the facts of geology. The position and character of the Rubble-drift shows that the transition from the so-called Post-glacial beds to the recent alluvial deposits is abrupt, and there is no absence of sedimentation or anything indicative of lapse of time between the two series. This conclusion is confirmed by sections of the Belgian caves.

Neither is the Croll theory, in the opinion of the writer, warranted by archeological evidence, for "it is hardly probable," to quote the author, "that Man, who showed himself progressive early in the Quaternary period, could towards its close, have remained for, say 70,000 years, without further progress than that shown by Man of the early Stone period. There is nothing to represent, geologically, that long period of time, nor have biologists been able to detect any essential structural differences between Palæolithic Man and Neolithic Man in support of such a conclusion. All the evidence tends to prove that late Glacial (or post-glacial) Man, together with the great extinct Mammalia, came down approximately to within some 10,000 or 12,000 years of our own times, and that the Rubble-drift marks the stroke of the pendulum when the Glacial period came to a close, and the Neolithic age commenced."

A number of cuts and a map of western Europe showing the chief places submerged illustrate the text (Phil. Trans. Roy. Soc. London, Vol. 184, 1893).

Geological News, General.—According to Mr. Oldham, the three main divisions of India are natural regions. The peninsula consists of land which has not been submerged since the early Paleozoic period. The continental has been frequently under water until the Cenozoic, while the great plain is recent alluvium. There is paleontological evidence of a continuous land connection between India and Africa in the Cretaceous period. At the close of the Cretaceous there was an outbreak of volcanic activity contemporary with a series of earth-movements which led to the first appearance of the extra-peninsular mountains, and the depression at the base of the Himalaya. This activity continued during Cenozoic time. (Nature, Dec., 1893.)

Mr. Robert Hay gives some interesting results of a boring made at Paola, in eastern Kansas, which reaches a depth of 2,500 feet. After passing through the coal measures and subcarboniferous it is difficult to determine the formations, the samples being so finely comminuted. At 2,100 feet granite is reached, at first a gray granite—angular quartz and mica with some feldspar—and then a red feldspar with little mica and no quartz, like the outcrop at Ute Pass, Colorado. (Trans. Kansas Acad. Sci., Vol. xiii).

Archean.—In a study of a group of quartzite exposures in southeastern Wisconsin, Mr. Buell finds evidence of dynamic action accompanying the metamorphism of these rocks which is at variance with the more common structure of the pre-Cambrian quartzites of the region of the Great Lakes and Upper Mississippi, as described by Dr. Van Hise. These differences afford criteria for the separation of the quartzite drift of this area from boulder material from other sources and enables a more exact delineation to be made of the boulder trains that extend upon and within the different glacial formations of the Rock river valley. (Trans. Wisc. Acad., Vol. IX, 1893.)

Mesozoic.—Two new Ammonites from the Cretaceous rocks of Queen Charlotte Island are described by Mr. J. F. Whiteaves. Both specimens are small but clearly referable to the family of Stephanoceratidæ of Neumayer. The first, *Holcostephanus deansii*, belongs to the small group of which *H. astieri* is the type ;the second, *Hoplipes haidaquensis*, is very similar to *H. sinuosus* of the French Neocomian. (Can Record Sci., Oct., 1893.)

According to Mr. S. W. Williston the thickness of the Niobrara rocks in Kansas have been underestimated. Repeated observations at Elkader, in Logan Co., give 290 feet between the bottom of the valley and the highest Niobrara rocks. Wells in the vicinity penetrate 40 feet without passing through the blue chalk. To this, for stratigraphical reasons, he adds 100 feet, giving as a minimum 430 feet at a total thickness at this place. (Trans. Kansas Acad. Sci., Vol. XIII.)

Cenozoic.—Mr. C. T. Simpson reports eight species and one variety of Unios and six species of other fresh water shells from the drift of Toronto, Canada. All the Unios are characteristic forms of the Mississippi Valley, and only three have ever been reported before from Canada. The fossils were obtained from a bed of sand between two glacial beds in a railway cut, 20 or 25 feet above the River Don. Mr. Dall calls attention to the important bearing which these fossils may have upon the theory of a mild interglacial period, during which these Mississippi species attained that region where they flourished for a time and were then destroyed by an advance of the ice. (Proceeds. U. S. Natl. Mus., Vol. XVI, 1893.)

Reasoning from the data gathered for a study of the age of the extra-moraine in eastern Pennsylvania, Mr. E. H. Williams concludes that the total time of the Ice-Age, from beginning to end was small, and of so recent a date that the streams have not reached, in all cases, their pre-glacial bottoms, and the exposed rocks have not had time to acquire signs of decomposition or even oxidation. He inclines to the belief of but one ice age, and that a short and recent one. (Am. Journ. Sci. Jan., 1894.)

Mr. Alfred Bell notes the unique fauna of a post-Tertiary deposit on the shores of the Selsey peninsula in Sussex. Over 330 species in nearly all classes of organic life have been collected, the series exhibiting a purely southern facies free from any northern or boreal forms. An analysis of the list gives the following result: Non-marine, 8 Mammalia, 10 Mollusca, some fragments of insects and 3 plants. Marine, 2 Pisces, 6 Crustacea, 17 Entomostraca, 4 Cirripedia, 4 Annelida, 3 Echinodermata, 216 Mollusca, 10 Polyzoa, 50 Foraminifera, 4 Actinozoa, Algæ, etc. (Annual Report Yorkshire Phil. Soc. for 1892.)

The Manus of Hyopotamus.–Among the treasures obtained in the White River bad lands of South Dakota by the Princeton expedition of 1893 was a fine skeleton of *Hyopotamus*, which was found by Mr. J. B. Hatcher. This specimen presents a number of very unex-

pected characters, which will be described in a full account of the species, with plates, which is now in preparation. Of these, the most striking is the structure of the fore-foot, *which proves to have five well developed digits*, although the genus is a typical artiodactyl. *Hyopotamus* is thus the third artiodactyl genus in which the manus has been shown to possess five digits, the others being *Oreodon* from the White River and *Protoreodon* from the Uinta Eocene. Kowalowsky's material belonged to many different individuals, and when put together, did not suggest the presence of the pollex. In the specimen before us the first metacarpal is proportionately much longer and heavier than in *Oreodon*; its length is 41 mm. while that of the third metacarpal is 94 mm. It is quite stout, especially anteroposteriorly, and laterally compressed, with well formed distal trochlea, which demonstrates the presence of phalanges. The trapezium is large, but strange to say, has but slight connection with the scaphoid. The proximal surface of the magnum is occupied principally by the scaphoid, though to a less degree than in the oreodonts. The other metacarpals (II–V) are heavier than those which Kowalwsky has figured.

This specimen renders it altogether probable that the earliest artiodactyls were all five-toed and that the larger number of the Eocene members of the group will prove also to have been pentadactyl, though even as early as the Bridger some genera had been reduced to a didactyl condition.—W. B. Scott, Geological Museum, Princeton, N. J., Jan. 16, 1894.

MINERALOGY AND PETROGRAPHY.[1]

Globular Granite in Finland.—An occurrence of spherical granite is reported by Frosterus[2] from the southern and eastern portions of Borga in South Finland. In the midst of a number of knolls of red or gray microcline granite, is one in which spherical nodules are plentiful. Of the rock forming this knoll there are two varieties distinguished by the difference in size of their nodules. In one the nodules are small and consist of a light covered zone surrounded by a dark periphery composed of two or three concentric biotite shells. The kernel is a granular aggregate of oligoclase, some microcline, a little quartz, and considerable biotite toward the center. The rock enclosing the nodules is a dark gray granite in which quartz and microcline are more abundant than in the nodules. In the second variety of rock the nodules are large. Their kernels are like the small nodules described. Around these is usually a narrow band of feldspar and around this a zone of mica. The rock in which the spherules lie is a grayish red granitite.

After investigating carefully the relations of the minerals in the nodules to each other and the relations existing between the nodules themselves, the author concludes that the spherules existed as plastic bodies in the rock magma while this was still liquid. When in contact with each other the nodules are often distorted, whereas at other times they are broken across. It is believed that the mica and other more basic components first separated in the form of a shell enclosing some of the rock's magma, that afterward gave rise to the granular nucleus upon cooling. The nodules are thus looked upon as basic concretions, and since they are distributed through a few restricted areas only, they are thought to form basic "Schlieren." The author's article is well illustrated by several handsome plates.

The Inclusions in the Basalts of the Oberlausitz.—A further study of the granite inclusions in the basalts of Oberlausitz by Beck[3] adds a few items of information concerning the contact action between volcanic rocks and their included fragments. On the Hirschberg the granite inclusions in nepheline-basalt have had pro-

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Minn. u. Petrog. Mitth., XIII, p. 177.

[3] Minn. u. Petrog. Mitth., XIII, p. 231.

duced in them spinels and augite. The dyke melilite-nepheline-basalt near Kemnitz becomes porphyritic around the inclusions. Spinels and augite are again the principal new products formed in the granite, but in addition to these glass nodules containing chalcedony and tridymite are also found in the inclusions. On the basalt side of the contact nepheline is lacking and feldspar takes its place, while the olivine of the original rock is broken and corroded. Around a few of the inclusions a mineral of the hauyne group has developed. The nepheline-basalt of the Spitzberg near Paulsdorf, contains a very large number of included fragments, around which the course of the contact processes may be easily studied. Around some of them is an isotropic glass containing microlites and trichites, while one large inclusion made up of many fragments is discovered under the microscope to have its pieces cemented by glass in which are feldspar and quartz fragments, and now and then small crystals of augite forming 'crowns' around the quartzes, besides biotite, granular colorless olivine and crystals of cordierite, which are always associated with magnetite. As the distance from the inclusion increases, the quartz and feldspar gradually disappear, augite increases in quantity and olivine of the basalt type becomes prominent. The rock then differs from the normal nepheline-basalt mainly in containing feldspar and in the absence of nepheline. Of course, at a greater distance from the inclusion, the rock assumes its normal composition.

Thermometamorphism around the Shap Granite.—In a paper published some two years ago and abstracted in the Bulletin of the Geological Society of America[4], Messrs. Harkes and Marr[5] discussed the interesting effects produced upon andesite and rhyolitic lavas and tufas and upon limestones and slates by the intrusion through them of a great mass of granite at Shap Fell, in the Lake District, England. The same gentlemen return[6] to their study in a late paper, supplementing and correcting their former statements. They find in addition to the andesites and rhyolites, sheets of basalt or of a very basic andesite, containing monoclinic and orthorhombic pyroxenes, and like the other lavas characterized by an abundance of vesicles filled with products of weathering. These have suffered contact alteration to a greater extent than have the primary constituents, though all have

---

[4] Bull. Geol. Soc. Amer., Vol. III, 1892, p. 16, cf. AMERICAN NATURAILST, 1892 p. 847.

[5] Quart. Jour. Geol. Soc., XLVII, 1891, p. 266.

[6] Quart. Jour. Geol. Soc,, 1893, XLIX, p. 359.

been affected near the contact with the granite. Green hornblende, brown mica, colorless pyroxene, epidote and sphene are the most conspicuous new minerals formed. These lie in a clear, granular mosaic, which may consist of newly developed quartz and feldspar. The components of the vesicles have in most cases given rise to a mixture of hornblende and quartz, but in other cases a little calcite may remain unaltered in the center of larger vesicles, while surrounding it are usually hornblende, colorless pyroxene, quartz and epidote, and sometimes in addition, zonal garnets, sphene and a few other minerals. The feldspar found within the vesicles of metamorphiosed andesites is thought by the authors to be the result of the weathering of these rocks rather than a product of contact action. In concluding their paper some interesting thoughts are suggested as to the source of the materials producing contact minerals. It is known that limestones when pure may recrystallize as marbles without the production of contact minerals, but that when impure the silica in the impurities may (and generally does) release the carbonic acid and recrystallize with the calcium as silicates. In some of the vesicles of the rocks around the Shap granite, however, the calcite has recrystallized, with the formation of silicates only around the edges of its mass, proving plainly that silica was obtained for the production of the silicates only by the calcite immediately in contact with the silicates. The conclusion is that in cases of thermometamorphism no transference of material takes place within the mass of the altered rocks except between closely adjacent points. In the production of the lime silicates studied, the interchange of lime and silica is estimated to be limited to a distance of $\frac{1}{20}$ of an inch. Other observations indicate the correctness of this conclusion.[7]

Petrographical News.—In the Obersweiler gneiss of north Vogesen are dykes of basic rocks that Andreae and Tenne[8] identify as hornblende kersantites. They consist of a panidiomorphic aggregate of plagioclase, green hornblende, a little mica, quartz, apatite, etc. Other dykes of the region are quartz-melaphryes of the navite type. The quartz is undoubtedly original. Its grains are much corroded and the resorption rims around it are composed of augite and glass. The rock is interesting as the first recorded example of a dyke rock corresponding to the volcanic quartz-basalts.

The porphyritic granite of northern Lausitz contains large numbers of apatite crystals, sometimes as many as a hundred in a single

---

[7] See also Journ. of. Geol., Vol. I, p. 574.

[8] Zeits. d. deutsch. geol. Ges. 1892, p. 824

thin section. As large as is this number it is exceeded in sections of the basic concretions of the rock from Niedersteina. These concretions according to Hermann[9] are made up largely of hornblende and cordierite, and thousands of apatites, sometimes reaching 1200 in a single section. The interesting features of these apatites is not, however, their number, but their forms. In many cases they are skeleton crystals whose many branches are parallel like the teeth of a comb.

The Hour-Glass Form of Augite.—This well known form of augite, according to Blumrich,[10] is usually connected with zonal growth in the mineral, and is limited in its occurrence to the pyroxene of alkaline rich magmas. It is found not only in augite, but also in other minerals forming colored isomorphorus mixtures. The hour-glass form owes its existence to the fact that different crystallographic faces in a growing mineral attract molecules of different chemical compositions, which by addition to the attracting faces build out these faces with differently colored substance. The structure is certainly not due to the filling in of the outlines of skeleton crystals, as has often been assumed. Zonal bands extend uninterruptedly through both dark and light areas in the crystals, hence the materials of both must be of the same age. The one cannot have been a later deposition than the other. Pelikan[11] in confirmation of Blumrich's view, calls attention to the fact that if strontium nitrate crystals be allowed to grow in certain colored solutions, they become colored in areas distributed in accordance with the faces by which the crystals are bounded. The central cores of chiastolite crystals, Becke ascribes in a similar manner to the attractive influence of the end faces of the crystals upon the material added during growth.

The Effect of Impurities in Crystallizing Solutions.—It has long been known that the habit of crystallization assumed by a substance depends in large measure on the medium from which it crytallizes. Araganite, for instance, will separate from certain solutions, while from others calcite is precipitated. Vater[12] has conducted a series of experiments with calcium carbonate, allowing this substance to crystallize from various solutions under different conditions; and has reached some interesting conclusions. The ground rhombohedron

---

[9] Neues Jahrb. F. Min., etc., 1893, II, p. 52.

[10] Minn. u. Petrog. Mitth., XIII, p. 239.

[11] Ib. XIII, p. 258.

[12] Zeits. f. Kryst. XXI, p. 433 and XXII, p. 209.

of calcite separates from all solutions of pure carbonate in dilute carbonic acid at low temperatures. In general, under different conditions of formation, differently habited crystals are produced. Moreover, different proportions of impurity in the solution affect differently the resulting crystals, as well as the rapidity with which they grow. Contrary to the prevalent belief, however, the presence of calcium bicarbonate in a solution of the mono-carbonate exerts but little influence upon the complexity of the calcite crystals formed. The article is long, and is a thorough discussion for the subject treated.

North Carolina Quartz Crystals.—Gill[13] supplements Von Rath's study of North Carolina quartz crystals by describing some new forms and giving the results of etching spheres made from simple left-handed crystals with hydrofluric acid and hot sodium carbonate. The conclusions of his crystallographic study are to the effect that the mean of the measurements of 38 crystals give an axial ratio $a : c = 1 : 1.1018$. This ratio, which is larger than usual for quartz, is ascribed to the lengthening of the c axis brought about by impurities included within the crystals. All the crystals investigated were smoky quartzes, whose axial ratio approaches that of the Swiss crystals, and is larger than that of the Riesengrunde occurrences (1: 1.0996). The crystallazition is trapezohedral-tetartohedral, which may be best regarded as *a combination of trapezohodral hemihedrism* and hemimorphism with respect to the lateral axes. The author notes the effect of various influences upon the development of the planes observed on quartz, and closes his paper with a discussion of crystal structure. The properties of quartz are explained upon the assumption of a molecule of SiO_2 in which Si is in the center of a regular tetrahedron, from whose upper and lower edges the oxygen exercises its influence.

Two New Books.—Hatch's mineralogy[14] is an elementary text book for the use of beginners in the study of minerals. The book begins with a very elementary treatment of the systems of mineralogy based in the notion of symmetry. It defines the terms made use of in describing the physical properties of minerals and ends with seventy-five pages on systematic mineralogy. The classification used is an arbitrary one—the rock-forming minerals being first discussed, then the ores, next the salts and other useful compounds and finally the

---

[13] Zeits. f. Kryst., XXII, p. 97.

[14] Mineralogy by F. H. Hatch, London, Whittaker & Co., 1892. Pps. viii and 224. Ills.

gems. The descriptions are clear but very brief and the illustrations in the text are well selected. The little volume is one of the best of its kind, though this is but scant praise.

Gregory's translation[15] of Loewinson-Lessing's Tables for the Determination of Rock-Forming Minerals, adds another to the number of books thut are supposed to aid the student in the rapid determination of the most common constituents of rocks. The tables are intended to lead their user to the *name* of the mineral whose characteristics he has observed under his microscope. It is a "guide to the identification of minerals, rather than a summary of their properties." The plan made use of in the construction of the tables reminds one of the schemes familiar to the determinative botanist. Habit, color, lustre, character of double refraction, etc., serve to place the minerals in different groups, from which one whose name is sought is selected by its special characteristics. The tables appear to fill a want, but only constant use in the laboratory will prove whether or not they will assist the student to the extent hoped by the author.

Mineralogical News.—*Azurite* with the habit of Chessy crystals and large *cerussites* prismatic in the direction of the brachydiagonal are mentioned by Molengraff[16] from Willow's silver mine near Pretoria in the Transvaal. On the former the three new planes $\frac{1}{10}\breve{P}\infty$,—2 $\breve{P}3$ and $\frac{1}{3}\breve{P}3$ occur.

On three highly modified crystals of *phosgenite* from Monte Poni, Sardinia Goldschmidt[17] has discovered the new forms $P\frac{3}{2}$ and $3P\frac{3}{2}$ The distribution of the more common faces seems to point to a trapezohedral symmetry for the crystals, but no circularly polarizing effects could be detected in them. The axial ratio determined from the mean of the best measurements is $a:c = 1:1.0888$.

An analysis of *jarosite* from the cavities of the auriferous quartzite of the Buxton Mine, Lawrence Co., S. D., has been made by Headdon.[18] His results are:

SO_3	As_2O_5	Fe_2O_3	CaO	Na_2O	K_2O	H_2O	Total
30.29	2.51	49.28	.42	4.62	1.57	11.24	= 99.93

---

[15] F. Loewinson-Lessing's: Tables for the Determination of Rock-Forming Minerals. Translated by J. W. Gregory, With a chapter in the petrological microscope. London & N. Y., MacMillan & Co., 1893. Pp. 55.

[16] Zeits. f. Kryst., XXII, p. 156.

[17] Ib., XXI, p. 321.

[18] Amer. Jour. Sci., XLVI, 1893, p. 24.

Three fragments of *powellite* have been obtained by Koenig and Hubbard[19] from the south Hecla copper mine in Houghton Co., Mich. The mineral has a density of 4.349. Its composition was found to be:

MoO_3	WO_3	CaO	MgO	Fe_2O_3	SiO_2	Cu	Total
67.84	1.65	27.30	.16	.96	1.52	tr	= 99.43

Native *lead* is reported by Kempton[20] as occurring in thin scales and pellets, some of which approach rectangular forms, in a gangue of pyroxene of a pale green color. It is associated with iron oxides and calcite. The location given is near Saric, Sonora, Mexico.

Methods and Instruments.—Federow[21] in a recent article elaborates a new universal method for the measurement of crystals, suggests a new system for crystallographic nomenclature and illustrates a new method of projecting crystal planes, and determining by graphical means their symbols. The universal goniometer used in his investigations is described at length and pictured in detail. The author illustrates also the application of his method to studies in optical crystallography. He describes two models of universal microscope stages, constructed for the purpose of enabling the observer to revolve the object under investigation in two directions. The plagioclases are studied and it is shown that the labor of determining their nature is much reduced by the method of work suggested by the author. The paper is an important one and and one well worthy of close study.

Czapski[22] suggests the use of the iris diaphragm between a condenser of moderate strength and the stage of the microscope for the rapid interchange of parallel and converged light, and also the use of the same appliance in the ocular tube of the instrument for the isolation of the axial figures of very small crystals.

G. Friedel[23] gives a new method for determining the value of the double refraction in thin sections of minerals that seems to be simple in its application.

Goldschmidt[24] and Jolles[25] discuss two proposed methods for projection of crystal forms. Jolles article is illustrated by five plates and sixty figures.

[19] Ib., XLVI, 1893, p. 356.

[20] Science, June 23, 1893, p. 345.

[21] Zeits. f. Kryst., XXI, p. 574 and XXII, p. 229.

[22] Ib., XXII, p. 158.

[23] Bull. Soc. Min. Franc., XVI, p. 19.

[24] Ib., XXII, p. 20.

[25] Ib., XXII, p. 1.

BOTANY.

The Number of Plants.*—It is a question of science, and, if one will, also of reasonable curiosity, to ascertain approximately at least, how many are the plants which live upon the surface of our globe. And, in fact, almost every work of general botany devotes some attention to this subject. It is indeed true that the criterion of "species" is not equal for all botanists, some having a tendency to reduce, others to multiply (on the ground of very minute differences) the number in existence. The middle criterion of Linnæus, however, prevails by great length, which, somewhat improved, predominates in the classical works of De Candolle, Bentham, Hooker, Grenier, Godron, Koch, Asa Gray, Parlatore, Caruel, etc., etc. Admitted, however, some discrepancy in this criterion, the effect would be almost insignificant in comparison with the immense number of plants. Without enlarging too much upon the successive increases which the researches of the diligent have brought to the number of plants, I will sum up these results in a chronological table:

500–400 B. C.	Hippocrates	reckons	234	plants.
310–225 B. C.	Theophrastus	"	500	"
77 A. D.	Dioscorides	"	600	"
23–79.	Pliny	"	800	"
1650.	Caspar Bauhin	"	5,266	"
1704.	Ray	"	18,655	"

between species and varieties.

1771. Linnæus (see. Richter Cod. Linn.) reckons 8,551 species, of which 7728 are Phanerogams and 823 Cryptogams.

1807. Persoon (Syn. Plant.) reckons 20,000 species of Phanerogams.

1819. P. De Candolle (Theor. El.) reckons 30,000 species of Phanerogams.

1824. Steudel (Nom. Bot. I Ed.) reckons 70,000 species of Phanerogams and Cryptogams.

1841. Steudel (Nom. Bot. II Ed.) reckons 78,000 species of Phanerogams.

1845. Lindley (Veg. Kingd.) reckons 79,837 species of Phanerogams.

1885. Duchartre (Elem. Bot.) reckons 125,000 species, of which 100,000 are Phanerogams and 25,000 are Cryptogams.

---

* By P. A. Saccardo, translated by Roscoe Pound.

If we wish however to distribute the number of plants according to the principal groups and on the basis of the most recent monographic works, we arrive at the following result:

	NO. SPEC.	
Dicotyledons	78,200	See Durand Index Gen. Phan. 1888. where the numbers are taken from Bentham and Hooker Gen. Plant. 1862-1883.
Gymnosperms	2,600	
Monocotyledons	19,600	
Ferns	2,685	See Hook. and Bak. Syn. Filic. 1868-74.
Equis. Marsil. Lycopod.	565	See Baker Fern Allies 1887.
Mosses	2,303	See Mueller Syn. Musc. 1849-51.
Liverworts	1,641	See Gott. Lind. Nees, Syn. Hep. 1844.
Lichens	5,600	See Krempelhuber Gesch. Lich. 1870.
Fungi	11,890	See Strienz Nom. Fung. 1862.
Algae	6,200	See Kutzing Spec. Alg. 1849.
Total	131,104	

But this number (131,104) is greatly increased by recent and vigorous contributions made especially in the vast field of the Cryptogamia in consequence of the improvements made in the microscope and the increased number of observers. In fact, according to Underwood, the American hepaticologist (cfr. Bot. Gaz. 1892) from 1844 to the present time the number of Liverworts by researches made in more regions of the world has doubled. And as for the Algae according to my learned colleague, G. B. De Toni, upon documents collected by him and in part published in his admirable Sylloge Algarum, the number of species described up to to-day is distributed as follows:

	NO. SPEC.	
Chlorophyceae	2,798	(Syll. Algar. Vol. I, 1889.)
Cyanophyceae	800	about.
Phaeophyceae	1,100	"
Florideae	2,100	"
Bacillariaceae (Diat.)	5,000	(Syll. Algar. Vol. II et seq.)
Characeae	200	
Total	12,178	

Whence it appears that this vast group, too, has doubled since 1849.

Then in regard to the Fungi the results obtained in the active and multiplied researches of the last twenty years have surpassed all expectation. The number of species, in fact, reported in Vol. X of my Sylloge Fungorum and which goes to May of the current year, 1892, attains the marvellous sum of 39,663, that is to say, that in thirty years the group of Fungi has almost quadrupled.

We should therefore join to

Sum Total	131,104 (above indicated)
For the Liverworts	1,400
For the Fungi	27,773
For the Algae	5,978
and we have	166,255

This sum is deduced from positive data and it is annoying that on the other vegetable groups there is no information summing up the latest additions. However, to judge from the most recent botanical periodicals, as the Botan. Jahresbericht, the Botan. Centralblatt, the Monographiae Phanerogamarum, etc., etc., one cannot deny that the Mosses[1] have doubled since 1851 and that the Phanerogams and Ferns have increased almost five per cent.[2]

Thus we shall have:

Sum total preceding	166,255
For the Phanerogams an increase of	5,011
For the Ferns	134
For the Mosses	2,306
Total	173,706

Which sum, then, represents with great approximation the true number of species of plants known up to the present time, that is 105,231 Phanerogams and 68,475 Cryptogams thus distributed:

---

[1] The celebrated bryologist Schimper in the preface to his Synopsis Muscorum 1860-1876, thought that the Mosses of the whole world, when known, would amount to more than 8,000 species.

[2] The publication of the new and great Nomenclator Plantarum is eagerly awaited, already in part printed at London by the munificence of Darwin. From this one will be able to state exactly the real increase of the Phanerogams in these last years.

	NO. SPEC.
Phanerogams	105,231
Ferns	2,819
Equis., Marsil., Lycopod.	565
Mosses	4,609
Liverworts	3,041
Lichens	5,600
Fungi	39,603
Algae	12,178
Total	173,706

When we consider the many regions which still remain to explore or are imperfectly explored, it is beyond doubt that the number of plants will still increase very greatly. And one may be certain that it will be the number of the cellular Cryptogams which will receive the greater increase, as compared with the higher plants. In fact the perfections of the microscope which permit the convenient study of these most minute productions are, we may say, of yesterday, and the prodigious conquests of these last years, accomplished above all in the field of the Cryptogams are proof of this.

But the chief design that moved me to write this short note regards the probable number of Fungi to appear. From a few hundred forms which were known at the beginning of the century we have jumped, as has been seen, to about 12,000 species in 1862, and to-day we have nearly 40,000 of them. An astonishing progression, which is not explained solely by the increase of investigations, but reveals the enormous and scattered mass of fungous forms. It has been objected by several botanists that the specific autonomy of many Fungi is not founded on a secure basis and that many such species are rather to be considered as "forms of substratum", that is variations of the same species by reason of the different substratum or matrix in which they grow. I do not wish to deny that several admitted species may find themselves in this situation, but it is to be observed that in beings for the most part simple and microscopic the differential characters cannot be of great importance to our eyes, and hence it is necessary to go slowly before refusing them as good, as one must observe principally their constancy.

After all, on the subject of these suspected forms of substratum, this is a fact worthy of much consideration, that we very often see upon the identical living matrix several species of the same genus maintain themselves, most distinct, although related, as happens, e. g., in the

genera Sphaerella, Diaporthe, Leptosphaeria, Pleospora, Phoma, etc., etc. If the matrix had acted to modify the characters of Fungi, why should we find mingled together on the same branch, on the same leaf, two Diaporthes, two Sphaerellas, perfectly distinct? I am therefore convinced that a reduction of species will have without doubt to be made, but always with great caution, retaining also on this subject the just precept: melius est distinguere quam confundere.

In the number of the Fungi are comprised also the so-called imperfect forms (Sphaeropsideae, Melanconieae, Hyphomyceteae) which amount to about 10,000 species. These, in the judgment of some mycologists, ought to be excluded from the census of species; but this does not seem just, because, if for some few we know for certain that they form part of the metagenetic cycle of known perfect forms, it is more certain still that of the greatest part we know nothing positively of their metagenesis and are able to suspect that they are permanent forms of which the perfect state either has disappeared, or is wanting or is very rare. Why then should we exclude from the census of fungi beings distinct and constant?

We have seen that in only thirty years the number of fungi has increased by almost 28,000 species. I may add that an increase of certainly 8,100 species belongs to the brief period from 1882 to 1890 (cfr. Suppl. Syl. Fung.) in spite of the fact that my Sylloge Fungorum was published contemporaneously, a repertorium of all the Fungi hitherto described. Now we ask ourselves: to what results will the already well-begun mycological researches lead us when we have extended them to the whole world and to all fungus-bearing hosts? Some example can perhaps enlighten us a little on this journey still to be made. One of the best known regions (although not perfectly) in respect to the Phanerogamic flora more than the Cryptogamic, is without doubt the Venetian region. In this, according to the enumeration made by the well known Professor De Visiani in his work of 1869 (Catalogo delle piante vascolari del'veneto) we have 2939 Phanerogams, a number which even to-day remains almost unchanged. For the Cryptogams we have the accurate work of the G. Bizzozero published in 1885 (Flora Veneta Crittogamica, Ven. 1885), where the Venetian Cryptogams amount in all to about 6,000 of which 4,200 are fungi, a number raised now to about 4,800 by the researches of Professors A. N. Berlese, C. Massalongo, etc.

If the number of Venetian Phanerogams studied diligently from more than a century ago till our own time could not with new studies increase more than a very small number of species, it is positive that

the number of fungi will increase considerably. In fact the Venetian Hymenomycetes were until now scarcely studied and the interior provinces like those of Venezia, Rovigo, Vicenza, Belluno, Udine, which comprise the Alpine region which will give us without doubt a large contribution of new forms, are in a mycological respect almost entirely unexplored. I am therefore convinced that when all the Venetian territory is well explored, we will have at least 7,000 fungi in its Flora, a number which compared to that of the Phanerogams (2,939) surpasses it by certainly 4/3. According to this proportion if we have today more than 105,000 Phanerogams in all the world, the fungi in order to exceed them by 4/3 ought to ascend to about 245,000. This calculation cannot be accused of exaggeration when we see that the greatest part of the fungi being parasites, a connection between them and the hosts (for the most part Phanerogams) must necessarily exist.

But this is not all. We have rich and accurate repertoria of fungi according to their hosts; as the general one of Westendorp, the one for Venice of Cuboni and Mancini; the very recent one for North America of Farlow and Seymour. A glance at these repertoria shows us at once that there are very many Phanerogams which harbor parasitic fungi by tens and hundreds many of which are exclusive to them. We have moreover careful monographs of the fungi which grow upon the vine (Pirotta, Thuemen), on the Lemon and Orange (Penzig), on the Mulberry (Berlese). Now the fungi which grow upon the vine are according to the last census of Thuemen (1892) in number 595, those on the lemon and orange 190, those on the mulberry 200. When we consider these hosts as generic groups (Vitis, Citrus, Morus) and calculate that for each of these groups alone, on an average, 40 per cent. of the parasitic fungi are exclusive to them (and not wandering or pantogenous) we have: for the genus

Vitis, proper species of fungi	238
Citrus	76
Morus	80

the average of which numbers is 131. Now the genera of greater plants of Phanerogams being, according to Bentham and Hooker 8,417, if we reckon 131 fungi proper for each one of these genera, there results the huge cypher of 1,102,627 parasitic fungi, to which must be added that of terrestrial and non-parasitic (about 11,000) in all 1,113,627. Certainly this number does not appear at all impossible when we think that the data are taken from genera (Vitis, Citrus, Morus) which contains few species in comparison with others (e. g. Solanum, Astragalus, Euphorbia) which possess several hundred more of them, which with-

out any doubt have peculiar fungi. Nevertheless reflecting that several species or groups of plants are notoriously attacked by a less number of fungi; that in certain regions of the globe, whether because of dryness, or because of the scarce vegetation parasitic fungi are also rare;[3] finally that woody natures, as the three taken for data, are habitually more attacked by parasitic fungi than the herbaceous, I believe I shall be held just and in every way conservative in calculating only thirty parasitic fungi, on the average, for each genus of Phanerogams. We have thus 252,510 species of parasitic fungi, which united to the recorded non-parasitis amount to a total of 263,510. The number of parasites (252,510) divided among all the known species of Phanerogams (105,000) would give us the reasonable number of a little more than two special fungi for each phanerogamic host, without counting that also the ferns, mosses, liverworts, and even the greater fungi, offer an asylum to not a few fungous parasites.

This calculation deduced from the number of fungi for each generic group of Phanerogams accords more than sufficiently with the calculation previously made from the connection of the number of species of Phanerogams and that of fungi in a given area well explored, in a way that makes it appear that the total number of species of fungi, perfect and imperfect, in the whole world ought to ascend at least to the neighborhood of 250,000, that is to say, a little more than six times the number we know to-day.

To summarize, we may conclude that the species of plants known and described up to the present time are about 174,000, divided into 105,000 Phanerogams and 69,000 Cryptogams, that is in the lump 50,000 more than were admitted even in recent works. As regards, then, the entire number of species which cloak our globe, by the calculations alone which I have previously explained regarding the fungeous vegetation, I think we shall not go astray in estimating that the Flora of the world when it is completely enough known, will consist of at least 385,000 species of plants (that is, 250,000 fungi and 135,000 species of the other groups). If one wish only to reduce to 15,000 the species which will appear in these other groups (not fungi) the sum total of plants would ascend to 400,000 species at least.

[3] Mycologic geography and statistics are still little advanced. However if we see Europe almost in every part rich in fungi, if we see Argentina and Brazil, Cuba and the United States, Australia and New Zealand, Siberia, Ceylon, and Algiers varyingly but yet always rich in fungi, this signifies that they are liberally diffused at least over a great part of the world.

When shall we come to know well this enormous number of plants? If since 1824 the sum of plants has jumped from 70,000 according to Steudel, to the modern sum of 174,000, that is in 68 years we have discovered 104,000 species, to arrive at a problematical 400,000 about 150 more years of research ought to run. Our remote grandchildren will see whether these prophecies are verified, or whether in this we are greatly in error.—P. A. SACCARDO. [In Atti Cong. Bot. Int. 1892. Translated by Roscoe Pound.]

New Book on Ferns.—A book on the "Study of the Biology of Ferns by the Collodion Method," by Professor G. F. Atkinson of Cornell University is announced for early publication It is to be fully illustrated from original drawings by the author, and will include in the descriptive portion a discussion of the development, morphology and anatomy of the gametophytic and sporophytic phases, while a second part deals with methods of study. The house of Macmillan & Co. is to bring out the book, which will be looked for with interest by laboratory botanists.—CHARLES E. BESSEY.

ZOOLOGY.

Reappearance of the Freshwater Medusa, Limnocodium sowerbii.—Mr. E. Ray Lankester reports finding well-grown specimens of *Limnocodium sowerbii* in the Victoria Regia tank of the Sheffield Botanic Gardens. This jelly-fish was first noticéd in 1880 in Regent's Park, to which it had probably been transported from Brazil on the rootlets or leaves of a Pontederia. It was observed from year to year until 1891, when all trace of it was lost, and naturalists gave up the hope of carrying on any further investigation into its life history. Its appearance in Sheffield is accounted for by presuming that some reproductive germs were attached to the water plants sent from Regent's Park to re-stock the tank in Sheffield, April 4, 1892, and April 7, 1893. The curious thing is that in 1892 and 1891 no Limnocodium were seen in the original source, nor in 1893 except the few sent from Sheffield and placed there by Mr. Sowerby.

This beautiful little organism was first studied by E. Ray Lankester, who ascertained the following facts.

The jelly-fish appear suddenly each year as early as April or as late as August, and remain from five to twelve weeks, when they die down and absolutely disappear. When first seen they are extremely minute, 1/50 of an inch in diameter, and gradually develop to the full size of half an inch in diameter. Of the many hundred specimens examined in successive years, every one without exception were males. They produced abundant motile spermatozoa, but not a trace of egg-cell has ever been found in any one of them.

In 1884 Dr. A. G. Bourne described a diminutive polyp, not more than 1/8 of an inch long, devoid of tentacles which he found adhering to the root filaments of Pontederia in the same tank in which the Limnocodium was discovered. This polyp was supposed to be the "trophosome" of the Limnocodium medusa. That this inference was true was proved Dr. Fowler in 1890, who was fortunate in seeing the little spherical young found floating in the tank, nipped off by a process of transverse fission from the free ends of the minute polyps described by Bourne.

The next question, How do the polyps originate? has not yet been answered. They increase by budding, but never form colonies of more than four "persons."

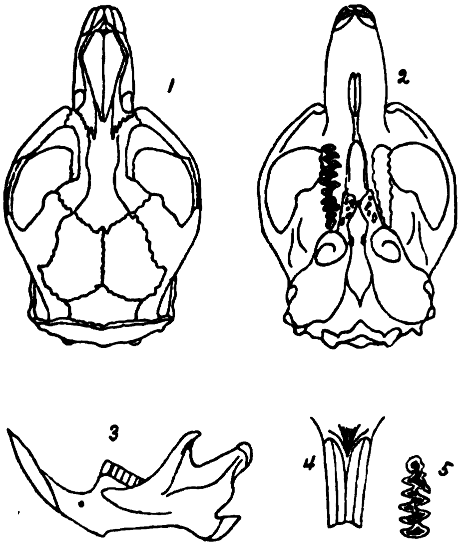
In conclusion, the author refers to the remarkable form worked out

by Mr. R. T. Günther during last winter, the *Limnocnida tanganyisiæ*, a fresh water jelly-fish from Lake Tanganyika. Individuals of three kinds are described by Mr. Günther, viz.: males, females, and asexual individuals which produce crops of buds on the manubrium While differing from Limnocodium in most respects, Limnocnida agrees with it in the minute structure of the marginal sense organs, According to Mr. Lankester no light is thrown by Limnocnida on the problem of the life history of Limnocodium. (Nature, Dec. 7, 1893.)

The American freshwater hydroid *Microhydra ryderii* Potts, is supposed to be a near ally Limnocodium.

Description of a New Genus and Species of Arvicoline Rodent from the United States, Rhoads, Gen. et. sp. nov. (Lake Kichelos, Kittitas County, Washington.)—AULACOMYS ARVICOLOIDES.—*Diagnostic Characters*—Skull large, massive, angular; malars parallel. Superior incisors long and slender (about equalling length of nasals), projecting anteriorly, strongly recurved and with flattened faces. A narrow, longitudinal sulcus equally divides the anterior face of each superior incisor, this groove, slightly magnified, showing a clear-cut, well-defined channel. To the naked eye this channel can be detected only on closest scrutiny. First lower molar with six angles on each side, two isolated triangles on the outer, and three isolated triangles on the inner side. On the inner side these are made up: 1, an inner posterior angle or shoulder of the anterior loop; 2, a rounded angle widely separated from the first but basally connected therewith by a continuous valley and reaching nearly as far from the median line as angle No. 3; 3, 4 and 5, large equidistant acute triangles of equal size, much larger and longer than opposing outer triangles and separated therefrom by a zigzag median line of enamel forming the alternating bases of opposing series of triangles; 6, the inner angle of posterior loop. Exteriorly the angles are formed as follows: 1. a rounded corner at the outer base of anterior loop; 2. a small angle abutting on the extended valley of anterior loop, said angle being anterior to plane of angle (No. 2) of the opposite side; 3. a rounded angle, widely separated from angle No. 2 of same side, due to the extreme posterior deflection of the crescent-like loop which angle No. 3 terminates; this loop is connected by a narrow valley with the anterior loop and in like manner with its preceding angle on the the same side and the two opposing angles, the five angles thus connected representing the four normally present in the anterior trefoil of recent *Arvicola, Evotomys, Synaptomys, Myodes* and *Cuniculus;* 4 and 5.

Two triangles of equal size, their bases formed by the median line of enamel connecting the bases of the three larger opposing internal triangles already mentioned; 6. A rounded angle of the posterior loop distinctly separated from its preceding triangle (No. 5) by full width of base of last inner triangle. The molar series are prismatic and non-rooted, Remainder of molar dentition much as in the genus *Arvicola*. Owing, however, to the greater relative depth and width of the entrant angles in *Aulacomys* the basal corners of opposing triangles of the lower molar series do not overlap as in *Arvicola* but stand distinctly upon their respective sections of the median enamel wall. Frontal bones flattened superiorly and lacking trace of supraorbital ridges. Nasals, short, abruptly triangular, terminating posteriorly in a point, very broad anteriorly and deeply notched subterminally. Nasal process of premaxillary, reaching behind anterior plane of orbits, far behind base of nasals and terminating in a slender point. Auditory bullae, triangular, narrow, not encroaching on basisphenoid, the tympanic process of the meatus (viewed from below) lying within lateral profile of the brain case. Postpalatal notch acute, terminating the hastate pterygoid fossa, so formed by the contraction of the pterygoids. Con-



AULACOMYS ARVICOLOIDES, Type.

Explanation of Plate.—1. Skull, from above. 2. Same, from below. 3. Exterior of left Mandible. 4. Anterior view of superior Incisors. 5. Crown of right, lower first Molar. (Figs. 1, 2, 3 & 4 x 1½ diameters; fig. 5 x 2½ diameters).

dylar ramus short and heavy with strong posterior shoulder forming a knob at base of condyle, containing the greatly extended root of lower incisor. Coronoid process, stout, erect and triangular. Angle very short and massive.

Body probably stouter than in *Arvicola*. Tail over half the length of head and body, sparsely and evenly coated with short spines and terminated by a well-defined pencil of slender hairs. Feet five-toed, each with five tubercles; claws long and slender. Whiskers pronounced, the longest reaching behind ears.

Aulacomys has the superficial appearance of *Arvicola* but with a very long and apparently naked tail and heavy whiskers. Cranially, it combines the molar dentition of *Arvicola* with the incisor dentition of *Synaptomys*. In these very respects, however, it differs from both genera—from *Arvicola* in the five-angled formation of the anterior section of the first lower molar, and from *Synaptomys* in the length, narrowness, protrusion and *central* sulcation of the upper incisors, also in the extension of the roots of the lower incisors far beyond the last molar.

The dentition of *Aulacomys* shows, in the number of angles of the anterior lower molar, an approach to the extinct form, *Arvicola* (*Anaptogonia*) *hiatidens* Cope, from the bone caves of Pennsylvania[1] but differs radically from it in the isolation of the triangles.

The absence of supra-orbital ridges, the posterior prolongation of the nasal premaxillary processes beyond nasals, the acute post-palatal notch, the shape of the pterygoid fossa and the massiveness of the posterior members of mandible are all, in a greater or less degree, diagnostic of *Aulacomys* as distinguished from other Arvicoline genera.

Specific characters.—Type, No. 1358; Ad., ♀. Col. of S. N. Rhoads, Lake Kichelos, Kittitas Co., Washington [Alt. 8,000 ft.], September, 1893. (Col. by Allan Rupert.)

Description.—Characters as decribed for genus. Above, reddish-brown, lined with black. Pelage, basally, everywhere plumbeous. Below, hoary plumbeous, lightest on throat. Upper parts of feet blackish. Tail very slightly darker above, than below. Ears not prominent, well-haired on both sides and with distinct valvular antitragus. Whiskers black.

Measurements (taken in flesh by collector).—Total length.—197;[2] tail 70; (taken from damp, relaxed skin), hind foot 27; ear 10; pencil 7.

---

[1] Proc. Soc. Amer. Philos. 1871, P. 91.

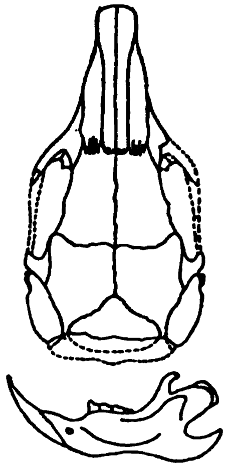
[2] Millimeters.

Skull.—Basilar length 29; total length (occipito-nasal) 31; zygomatic breadth 19; nasal length 9; interorbital constriction 5; interparietal breadth 7; interparietal length 4.9; crown length of molar series 7.4; greatest depth of cranium 10.9; length of mandible 20; height of coronoid process 11; ratio of zygomatic breadth to basilar length 65.5; zygomatic breadth to occipito-nasal length 58.

The specimen on which the foregoing characters are based was taken near Snoqualmie Pass on the Cascade Mountains. Out of a large series of rodents from this district it is the only specimen of its subfamily. It arrived in the form of a flat skin, reversed, with the skull separate and intact.—SAMUEL N. RHOADS.

Description of a New Perognathus collected by J. K. Townsend in 1834. PEROGNATHUS LATIROSTRIS. Sp. Nov.—Type, No. 694, ad ♂, Col. of Acad. Nat. Sci. of Phila.; "Rocky Mountains, J. K. Townsend;" Summer, 1834.)

Description—(mounted specimen, lacking tail, once preserved in spirits).—Largest known species of the genus. Upper half of head and body to root of tail, brownish-yellow, interspersed medially with black, spinous hairs, becoming purer brown on sides and bordered laterally from base of nose to tail with a broad ill-defined line of pure fulvous. No black tips to brown hairs of back, all hairs being unicolor from root to tip; black hairs coarsest. Pelage long and coarse throughout. Whiskers, slender, sparse, the longest reaching far behind the ears. Lower parts, feet, forelegs to shoulder, and inside of hind legs, dirty white. Ears pronounced, rounded, rather sparsely haired, with marked antitragus not higher than broad at base. Hind ears and spot over eyes fulvous. Hairs of base of tail same color as under parts all round point of fracture, seeming to indicate a unicolor tail. Soles hairless along median line to heel. Cheek pouches very large, external opening of same stretching from upper incisors half way to forelegs.



Perognathus latirostris, Type. (Enlarged one and two-sevenths diameters.)

Skull—(occipital and postero-mastoid region absent); cranium deep, slightly arched, as viewed from above, subrectangular; rostral portion very wide; interparietal bluntly mucronate anteriorly; coronoid pro-

cess erect, abruptly recurved near the blunt tip, anterior width of nasals nearly twice that of posterior width; a broad supraorbital furrow laterally borders the brain case from the lachrymals to the mastoid side of parietals, audital bullae separated anteriorly by full width of basi-sphenoid, molariform dentition as in *P. paradoxus*.

Measurements—(from mounted specimen); length of head and body 145; hind foot (shrunken), 27; ear from crown, 6.

Skull.—total length (approximate) .35; tip of nasals to interparietal 28.4; base of incisor to anterior tip of audital bullae 18; zygomatic width (at outer bases of squamosal process of malar) 17.5; interorbital constriction 8.8; length of nasals 14; nasal width (near tip) 4.2; nasal width (near base) 2.2; interparietal width 8.2; crown length of upper and lower molar series 4.6; length of median parietal suture 5; greatest parietal length (masto-squamosal) 10; length of mandible (inner base of incisors to condyle) 17.4; height of coronoid process from angle 8; greatest depth of cranium 11.

The specimen from which the above description is taken was collected by J. K. Townsend during his memorable Rocky Mountain journey nearly sixty years ago. It has been exhibited in the museum of the Academy during the greater part of that period and has lost its tail in the service. The locality given on the present label is only approximate, if correct at all, as an earlier entry of the specimen (probably copied from the original one) in the catalogue gives the specimen as "694, Thomomys rufescens, yg., J. K. Townsend, Columbia River." This name was, a long while ago, altered to "*Perognathus fasciatus*," as the museum label now stands. Probably the person making the last identification changed the given habitat to "Rocky Mountains" to accord with the habitat assigned to *fasciatus* by Baird. The specimen was probably taken east of the 34th meridan and south of the 43rd parallel, in Nebraska or Wyoming. It is not impossible that it came from a more western region. Its differentiation from its nearest ally, *P. paradoxus*, indicates a different faunal habitat from that occupied by the latter. Dr. Townsend makes no mention of the genus *Perognathus* in his list of the mammals observed during his journey, nor does Dr. Bachman, in his supplementary list of novelties published in the Journal of the Academy of Natural Sciences. It is possible that the specimen, owing to its mutilated (tailless) condition and being put in alcohol, was hastily overlooked, or classed as a young *Geomys* (the catalogue entry implies this), and later on it was mounted as such.

The specimen is over-stuffed, but does not appear unduly stretched laterally. From its appearance and the dimensions of its skull it is

evidently a larger species than *paradoxus*, the largest of the genus hitherto known. In many respects, notably of the dentition and general proportions of the brain case, and in size and coloration, *latirostris* resembles *paradoxus*, but is strikingly different in the size and proportions of the rostrum and of the interparietal. Owing to the loss of occipital portions I am unable to give the usual ratios for sake of comparison with Dr. Merriam's tables. *Perognathus latirostris* belongs to the *paradoxus* group of the subgenus *Chætodipus*.—SAMUEL N. RHOADS.

Zoological News.—MOLLUSCA.—The experiments in oyster culture carried on at Roscoff, France, have been extremely satisfactory. In a communication addressed to the Academy of Sciences at Paris, M. de Lacaze Duthiers gives a detailed statement of what has been accomplished. The spat were planted in a closed fish pond so situated that at high tide the sea water could find entrance. The young oysters grew rapidly, and in three years, that is to say the fourth year of their age, they were well grown and fine in flavor. During this year, young were produced in large quantities, thus settling the question of the age for reproduction in the oyster. (Pêches Maritimes, T. I, 1893.)

ARTHROPODA.—Mr. Walter Faxon reports 105 new species of Crustacea, some of which represent new genera, in the collection obtained by Mr. Agassiz in the dredging carried on by the U. S. Fish Commission Steamer, "Albatross," off the west coast of Central America and Mexico and in the Gulf of California, during 1891. (Bull. Harvard Mus. Comp. Zool., Vol. XXIV, 1893.)

According to Dr. C. O. Porat, the Syrian Myriopods collected in 1890 by Dr. Barrois comprises 19 species, many of which are new, distributed among 10 genera. In its general aspect this Syrian fauna resembles that of southern Europe and northern Africa, being intermediate in its characteristics. The species are described and figured in Revue Biologique, Nov., 1893.

VERTEBRATA.—The report of the U. S. Fish Commission for 1889–91 contains a review of the Sparoid fishes of America and Europe, by D. S. Jordan and B. Fesler. The family comprises about 55 genera and some 450 species, all valued as food, chiefly inhabiting the shores of warm regions. The authors consider the group closely allied to the Serranidæ on the one hand, the genus Xenistius being very close to the Serranoid genus Kuhlia; on the other hand, Scorpis, Cyphosus, etc., approach the Chætodontidae. Of the 12 subfamilies into which the

group is divided; 3 are exclusively American, and 2 are confined to the Old World.

M. Leon Vaillant describes a new genus of fishes from the Caroline Islands of which there are now two individuals at the Paris Museum. This fish resembles Fierasfer of Cuvier, but differs from it in the size of the dorsal fin, and more particularly in the character and position of its scales. In the Caroline genus the scales are distinctly separate, large in proportion and form a sort of network with lozenge-shaped meshes over the body; they are not imbricated, but merely touch, end for end. It is this singular arrangement of the scales that leads Mr. Vaillant to create a new species to which he refers these fish with the specific name *Rhizœketicus carolinensis.* (Revue Scientifique, Dec. 1893.)

A list of the Mammals of Rio Grande de Sul published by Dr. Herman von Ihering shows the following distribution: Marsupialia 11; Diplarthra 8; Cetacea 2; Edentata 6; Glires 24; Chiroptera 17; Carnivora 19; Pinnipedia 2; Quadrumana 3. (Rio Grande de Sul, 20, IV, 1892.)

From certain cranial and dental peculiarities, Mr. C. Hart Merriam considers the Yellow Bear of Louisiana a species distinct from *Ursus americanus* Pallas and *U. horribilis* Ord. He gives a description based on five skulls from Morehouse Parrish, Louisiana, and claims for it the name *U. luteolus*, given by Griffith in 1821. (Proceeds. Biol. Soc. Wash., Dec., 1893.) He thinks it is the Cinnamon Bear of Audubon and Bachman, but of this there is much doubt.

Two new species are added to the list of Mammals from East Africa; a dormouse, *Eliomys parvus*, closely resembling *E. kellenii*, and a mouse, *Mus tana*, allied to *M. musculus*. Both species are described by Mr. Frederick True in the Proceeds. U. S. Natl. Mus., 1893.

ENTOMOLOGY.[1]

North American Proctotrypidæ.—Mr. Wm. H. Ashmead furnishes in his Monograph of North American Proctotrypidæ,[2] one of the most important of recent descriptive works on American insects. In preparing the 457 pages of his text the author has had ample opportunities to work up our rich Proctotrypid fauna, studying in addition to the various American collections those of the Royal Museum of Berlin. Mr. Ashmead believes that the Proctotrypidæ are more closely allied to the Chrysididæ and Cynipidæ than to the Chalcididæ, next to which they are so commonly placed. He would separate the Mymarinæ as a distinct family allied to the Chalcids.

The lives of adult Proctotrypids are of short duration, not longer than four or five days in confinement, though probably longer under natural conditions. They occur in a great variety of situations, the favorite resorts of some being moist places where vegetation is luxuriant and insect larvæ abundant; others are found along the borders of woods or in the open fields; still others frequent fungi, and some occur in ant's nest. Comparatively few are found on flowers.

"There is scarcely any doubt but that many of the wingless forms to be found in various genera of this family are only dimorphic forms of winged species, although comparatively little is postively known on the subject." The eggs of these insects are "ovate or oblong in shape, with a more or less distinct peduncle at one end, and agree well in general with many in the family Ichneumonidæ, although those in the subfamily Platygasterinæ, on account of the longer peduncle, more closely resemble those in the family Cynipidæ." The larvæ are internal feeders, and in pupating plan for a protection of some kind.

"The Proctotrypidæ are apparent widely distributed over the whole world, although outside of Europe little is known of the exotic forms, and it is not possible therefore to generalize upon the genera and their distribution. From an examination of various exotic collections of Hymenoptera, it is safe to predict the species will be found to be numerous and widely distributed, but far less numerous than the Chalcididæ; judging from my own collecting I should say less than one-fiftieth in number. Only a small percentage of the species is yet described." The affinity of North American forms with those of

---

[1] Edited by Prof. C. M. Weed, Durham, N. H.

[2] Bull. 45, U. S. Natl. Museum, Washington, 1893.

Europe is shown by the way they fit into established European genera. South American species have required the erection of many new genera.

A large number of new species are described in the present monograph, which concludes with a full Bibliography and eighteen original plates illustrating structural details of members of the various genera.

Peculiar Oviposition of an Aphid.—During the autumn of 1890 I found a species of *Phyllaphis* on beech in central Ohio, the oviparous form of which agrees with Buckton's short description and figure of *P. fagi.* I presume that it is that species, but do not think the present evidence justifies a definite reference to that effect. The colonies were found on the underside of the leaves, with more or less flocculent matter about them. The sexed forms developed during October, and the oviparous females wandered over the bark of the twigs, limbs, and trunk in search of crevices in which to deposit their eggs. When a suitable place is found the egg is laid, and then driven into position by the following method: The insect so places itself that its hind legs easily touch the egg, then standing on its four front ones it brings the two hind ones down upon the egg in rapid succession, striking with considerable force. This serves the double purpose of pushing the egg in place, and of drawing out a viscid secretion, with which it is covered into a thread-like, silvery film, that so resembles the surrounding bark that it is difficult to detect it. I watched an oviparous louse go through this process for about a minute and a half.—*C. M. Weed in Trans. Am. Ent. Society, November,* 1893.

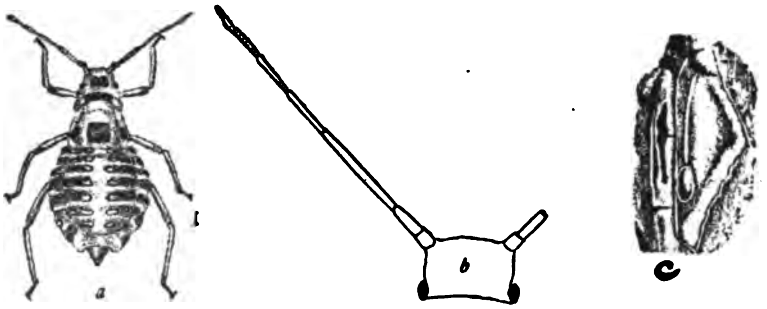


Fig. 1.—***Phyllaphis*** of beech: *a*, oviparous female, magnified; *b*, head and antenna of same, greatly magnified; *c*, egg on bark, magnified.

Pupal Development and Color in Imago.—Discussing the recent experiments of Merrifield in which lepidopterous pupæ were submitted to various temperatures and the results on the imagoes noted, Mr. J. W. Tutt briefly recapitulates[1] the well-known facts of histolysis and continues thus: "If we apply the simplest elementary laws relating to vital force to the pupa, we shall find that the following facts hold good:—(1). The pupa when first formed has a certain amount of inherent vital force by means of which both the processes of histolysis and rehabilitation are carried on in it. (2). That pupa which has the nearest approach to the normal amount of vital force will undergo the most perfect histolysis and rehabilitation, and will produce an imago most nearly conforming to what is known as the normal type, that is the type produced under the most healthy and satisfactory conditions. Conversely that pupa whose amount of vital force is farthest removed from the normal (whether in excess or in defect) is one in which histolysis and rehabilitation will be least perfect, and the imago produced will be the farthest removed from the normal type. (3). That individual which has been best fed and which had enjoyed the most perfect health in the larval stage, will enter pupal life under the most satisfactory conditions and will (the pupal conditions being equally satisfactory) emerge therefrom as the best specialized product, whilst the converse to this must also be true.

"The second point also deals with an elementary principle. The vital force in the pupa is converted into energy; the energy at the disposal of the pupa is most probably directed first to the building up of the vital reproductive organs, and afterward to the secondary organs or tissues or such as are not necessary to life. Therefore an excess of energy in a pupa will be expended as a rule on secondary structures rather than on vital ones, and we find that a weak or diseased pupa fails first in regard to non-vital tissues, such as pigment, scales, wing-membrane, etc.

"The females of insects, as compared with the males require an excess of energy for those structures necessary to the reproduction of the species; they, therefore, have a smaller surplus to devote to the formation of the non-vital tissues, and as we well know frequently fail very markedly in their development of these.

"We are now in a position to understand that as a general rule pigment, scales, etc., are produced in proportion to the amount of material and energy available for the purpose.

---

[1] The Entomologist's Record, IV, 312.

"These and other general principles have to be considered when we attempt to discuss the results which Mr. Merrifield produces by his temperature experiments.

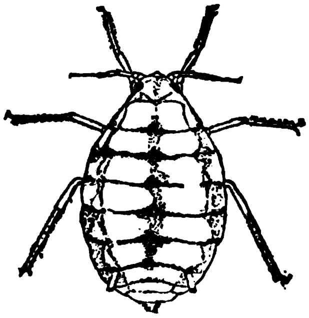
* * * "If now we apply these principles what do we find? Insects which are allowed to pass through their changes at the normal temperature produce the form which is normal for the district; that is they undergo the normal processes of histolysis and of rehabilitation, and in a state of health have at their disposal the energy requisite to give them their ordinary wing expanse, scaling and color. Now what does Mr. Merrifield do in his experiments? He subjects the pupa to a low temperature. This of necessity lowers the vitality of the pupa and so lessens the available energy. The insect therefore does not develop under normal conditions, and an abnormality is the result. The insect must use what energy it has to build up its vital organs, and fails in building up perfectly its secondary tissues—color, scales, wing membrane, and fails to in direct proportion to the degree in which the vitality is lessened. Below a certain temperature during the period of active development the vital force ceases to act at all, and the result is death. Heat, greater than that to which the insect is normally subjected, instead of lowering the vitality to the lowest ebb at which life can be sustained, affects the histolysis and rehabilitation in a directly opposite manner. Under its influence the vital processes are carried on at express speed. Energy is expended at the fastest rate possible, and the tissues are formed without having sufficient time to mature as they would under normal conditions, the surplus material is rapidly utilized, with the result that as marked an abnormality is produced under the one condition as under the other, although in an opposite direction."

Studying Insect Histories.—That the pursuits of the entomologists are not always so delightful as the chasing of June butterflies is shown by the following extract from a paper recently read by Mr. L. O. Howard before the Association of Economic Entomologists: To gain the clearest and most accurate idea of a life history, the insect must be studied under perfectly natural conditions, and not under conditions which more or less imperfectly simulate the natural ones. There is no easy road to the most perfect knowledge of habits. It involves tramping through mud and bramble patches; it involves the constant risk of sunstroke, and in our southern country the constant presence of Leptus and Ixodes (itch-mites and ticks); it involves constant watching and watching and watching, astride the small limb af a fruit tree,

perhaps, on your back under bushes, on your knees in the wheat-field, on your stomach in the pasture, with your face down close to a cow dropping, and with the summer sun beating down upon your unprotected head, watching and watching until the eyes grow dim; but in this way only are the unsolved problems in the life histories of injurious insects most satisfactorily worked out.

Biology of the Apple Aphis.—The common Aphis of the apple (*A. mali*) has for many years puzzled entomologists by its summer history. During June, usually, winged viviparous females leave the apple and disappear. In September other similar forms return to apple and give birth to the oviparous females which deposit the eggs on the twigs. In a paper on the insect foes of American cereals read at the recent meeting of the Association of Economic Entomologists, Mr. F. M. Webster of the Ohio Experiment Station gave a clue to the summer history in the following paragraph:

"It would appear almost visionary to advocate spraying apple orchards in midwinter to protect the wheat crop, but nevertheless one of the most serious enemies of young fall wheat passes its egg stage on the twigs of apple during the winter season. I refer to the Apple Leaf-louse (*Aphis mali* Fabr.), Soon after the young wheat plants appear in the fall, the winged viviparous females of this species flock to the fields, and on these give birth to their young, which at once make their way to the roots, where they continue reproduction, sapping the life from the young plants. On very fertile soils this extraction of the sap from the roots has no very serious effect, but where the soil is not rich, especially if the weather is dry, this constant drain of vitality soon begins to tell on the plants. Though they are seldom killed out right these infested plants cease to grow, and later take on a sickly



Apple Aphis; wingless viviparous female. Magnified.

look, and not until the Aphis abandons them in the autumn to return to the apple, do they show any amount of vigor."

This leaves the summer period still unaccounted for, but in the discussion which followed Mr. Webster's paper, Dr. C. V. Riley stated that he had "for a number of years known that this species had a summer existence on various grasses."[4]

Nematodes in Cecidomyia.—At a recent meeting of the *Société Entomologique de France*, M. A. Girard called attention to the observation of Kieffer[5] as to the existence of Nematode parasites in a female cecidomyiid (*Asynapta citrina* Kieff.). A fly of this species stupified by nitro-benzine emitted from the oviduct a compact mass of Anguillulas which placed in water moved about rapidly. Kieffer thought that the alimentary canal also contained these Nematodes, but Girard believes it to be a case where only the abdomen, especially the region of the ovaries is inhabited by the parasite. He reports a similar observation of his own, in which an undetermined cecidomyiid was the host. The body cavity was nearly filled with a Nematode of the genus Asconema and its embryos. The ovaries of the fly were atrophied by parasitic castration. The eggs of the Nematode developed in the body of the fly, and the latter laid the little Anguillulas in humid situations where they could develop.

Flights of Dragon-Flies.—In. Mr. W. H. Hudson's recently published *Naturalist in La Plata* there is an extremely interesting chapter on Dragon-fly Storms. In the Pampas and Patagonia, the larger species of these insects—especially *Æschna bonariensis* Raml., a pale blue form—frequently occur in enormous flocks which appear shortly in advance of a sudden and violent wind—called the *pampero*. "Inasmuch as these insects are not seen in the country at other times, and frequently appear in seasons of prolonged drouth, when all the marshes and water courses for many hundreds of miles are dry, they must of course traverse immense distances, flying before the wind at a speed of seventy or eighty miles an hour. * * * As a rule they make their appearance from five to fifteen minutes before the wind strikes; and when they are in great numbers, the air to a height of ten or twelve feet above the surface of the ground, is all at once seen to be full of them, rushing past with extraordinary velocity in a northeasterly direction. * * * * All journey in a northeasterly direction; and of the countless millions

---

[4] Insect Life, VI, 152.

[5] Berlin Ent. Zeitsch., XXXVI, 1891, p. 266.

flying like thistle down before the great pampero wind, not one solitary traveller ever returns."

These flights occur during the summer and autumn. Mr. Hudson thinks the cause "is probably dynamical, affecting the insects with a sudden panic, and compelling them to rush away before the approaching tempest. The mystery is that they should fly from the wind before it reaches them, and yet travel in the same direction with it.

* * * On arriving at a wood or large plantation they swarm into it, as if seeking shelter from some swift pursuing enemy, and on such occasions they sometimes remain clinging to the trees while the wind spends its force."

Mr. Hudson calls attention to Weissenborn's observation of a dragon-fly migration in Germany in 1839,[6] and his mention of similar flights in 1816. These occurred in May and the insects flew south.

An autumn flight of dragon-flies among the Alps has been described by W. Warde Fowler[7] whose attention was called to the flight by a waiter in an Alpine hotel. The latter had "observed a constant stream of dragon-flies making their way up the valley; and during my walks that day I was able fully to verify his statement. All the way from Haspenthal to Andermatl these creatures were to be seen coming up *against the wind*, which was now blowing from the west. There was no mistake about it; countless numbers were steadily passing up the valley, but whither they were going it was hopeless to ascertain; they did not seem to turn up the St. Gotthard Road, for I remarked them the whole way up the valley to the foot of the Furka Pass Westwards."

A Carnivorous Tipulid.—Professor L. C. Miall describes[8] the early stages of a crane-fly of the genus Dicranota with aberrant habits for Tipulidæ, the larvæ of which are mostly vegetable-feeders. This larva lives in the bottom of brooks or other water streams and feeds upon the red worms of the genus Tubifex. The head of the larva is small, the alimentary canal straight and the body is provided with spiracles and tracheal gills, so that the animal can breathe in or out of water. Pupation take place in moist soil.

Notes.—Mr. Albert P. Morse begins in the current issue of *Psyche* an important paper on the Wing-lengths of New England Acridiidæ,

---

[6] Mag. Nat. Hist. n. s,, v. III.

[7] A Year with the Birds, 202.

[8] Trans. Ent. Soc., London, 1893, 235.

and in the same issue Mr. S. H. Scudder publishes some interesting biological notes on American Gryllidæ. With this issue, *Psyche* begins its seventh volume.

Mr. G. C. Davis has prepared an interesting and valuable illustrated paper on insects injurious to celery. It is issued as Bulletin 102 of the Michigan Experiment Station.

Professor Herbert Osborn, Ames, Iowa, has bound together two of his recent papers on injurious Iowa insects which contain much valuable information. He offers a limited number of copies for sale at 30 cents each.

An excellent biographical notice of Dr. H. A. Hagen appears in *Entomological News* for December.

Professor M. H. Beckwith reports[1] that in Delaware during the past season crops of all kinds have been unusually exempt from the attacks of insects. In his summary of the year's work he discusses a number of injurious insects and experiments with remedies. The arsenites were found effective for the plum curculio, and the pyrethro-kerosene emulsion proved an excellent destroyer of aphides.

The last issue of *Insect Life* contains a full report of the Madison meeting of the Association of Economic Entomologists.

---

[1] Fourth Rept. Del. Ag. Expt. Station, 89–103.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Society of Naturalists.—The 12th Annual Meeting was held in the buildings of Yale University, New Haven, Ct., Dec. 27 and 28, 1893, Professor Chittenden of Yale occupying the chair. The meeting was largely one of business, and the following matters were discussed: A movement was inaugurated whereby a closer union could be effected between the Society of Naturalists and the affiliated societies of Morphologists, of Physiologists and Anatomists. Later the societies of Morphologists and Physiologists accepted the new scheme, which therefore goes into effect, so far as they are concerned, during the present year. It is hoped that later the societies of Psychologists and of Geologists will co-operate in the same way. By the new scheme all meetings will be held at the same time and place and a single notification and a single assessment will answer for all, while membership in one of the affiliated societies will carry with it membership in the Society of Naturalists. Another matter was the appointment of a committee consisting of Professors C. S. Minot of Harvard, S. I. Smith of Yale, H. F. Osborn of Columbia, Wm. Libby, Jr. of Princeton and William H. Howell of Johns Hopkins to appeal to Congress for action which should do away with that tax upon knowledge which is embodied in the customs duties upon instruments of research.. It was pointed out that these duties were not needed for the protection of the American manufacturer, for at least in one instance, American firms were ready to afford their goods at a price a little below the foreign manufacturers to those institutions which could obtain duty free prices, while for all others they added the extortionate 65 per cent. of the present tariff. The principal subject for discussion was the present status of our knowledge of the cell, the opening papers being by Prof. R. H. Chittenden of Yale, upon the subject from the physico-chemical standpoint, and by Prof. E. L. Mark from the zoological standpoint. Two illustrated evening lectures were given, one by Prof. L. A. Lee of Bowdoin upon a Comparative Study of Labrador and Patagonia, the other by Prof. Wm. Libby, Jr. upon the Physical Geography of the Hawaian Islands. At the Annual Dinner some 75 partook. The following officers were elected for the ensuing year: Pres., Prof. C. S. Minot of Boston; Vice Presidents, Prof. S. I. Smith of New Haven, Mr. Wm. H. Dall of Washington, Prof. Wm. Libby, Jr. of Princeton; Secretary, Prof. W. A. Setchell of New

Haven; Treas., E. G. Gardiner of Boston; Committee at large, Prof. H. F. Osborn of Columbia, Dr. C. W. Stiles of Washington.

SOCIETY OF MORPHOLOGISTS.—The annual meeting of this society was held at New Haven Dec. 28 and 29, 1893. In the absence of Prof. C. O. Whitman, Prof, E. B. Wilson occupied the chair. The following officers were elected for the ensuing year: Pres., Prof. C. O. Whitman of Chicago; Vice Pres., Prof. W. B. Scott of Princeton; Secretary-Treasurer, Dr. G. H. Parker of Cambridge; Executive Committee, Dr. E. A. Andrews of Baltimore and Prof. F. H. Herrick of Cleveland. Professors E. L. Mark of Cambridge and T. H. Morgan of Bryn Mawr were appointed as a committee to co-operate with a similar committee for the Society of Naturalists in the endeavor to secure the placing of scientific instruments upon the free list. The following papers were read: Bashford Dean, the significance of Kuppfer's vesicle. H. H. Wilder, on the Phylogenesis of the larynx. C. W. Stiles, the anatomy of Fasciola magna, and a comparison with other forms (F. hepatica, F. gigantea, and F. jacksoni). F. H. Herrick, the structure and functions of certain organs occurring in the appendages of the Lobster. Arthur Willey, on some points in the development of Molgula manhattensis. C. B. Davenport, on Regeneration of Hydroids. J. P. McMurrich, some points in the development of the Isopod Crustacea. C. S. Minot, apparatus for trimming paraffin blocks C. S. Minot, a comparison of larval and fœtal types of development C. S. Minot, on Gonotomes. C. A. Kofoid, some laws of cleavage as exemplified by Limax and other Invertebrates. H. E. Crampton, reversed cleavage in a sinistral gasteropod. W. A. Locy, the derivation of the Pineal Eye from accessory optic vesicles. Charles Hill, Epiphysis of Teleosts and Amia. G. H. Parker, the structure of the Rhabdome in Astacus. G. H. Parker, the optic ganglion in the Crustacea. W. B. Scott, on some Miocene Mammals, O. S. Strong, a new modification of the Golgi-Cajal method. Miss H. B. Merrill, preliminary note on the eye of the leech. Miss S. F. Langdon, the sense organs of Lumbricus. Dr. E. B. Wilson, a demonstrative object for the study of Karyokinesis.

The following demonstrations were given: C. W. Stiles, exhibition of specimens of Distoma westermanni, Stilesia globipunctata, Stilesia centripunctata, Dracunculus medinensis, Spurious parasites. J. P. McMurrich, Ganglion cells and larva of an ectoparasitic Trematode. O. S. Strong, nerves stained by the Golgi methods. Chas. Hill, Epiphysis of Salmo. F. E. Langdon, Sense organs of Lumbricus.

THE SIXTH ANNUAL MEETING of the American Physiological Society was held at New Haven, Conn., December 28th and 29th, 1893. The following papers were read: G. D. Goodyle, Concerning the Corrosive Action of Root Hairs. J. W. Warren, on the Zymogen of the Saliva. Wm. A. Setchell, Proteolytic Ferment of Drosera. C. F. Hodge, daily life of a Protozoan, Vorticella gracilis. C. S. Minot, on Growth. W. T. Porter, on Growth of Children. H. G. Beyer, Normal Growth and Physical development of the Human Body. J. H. Pillsbury, Color Sense. C. F. Hodge, a Comparative Study of the Fovea Centralis. E. W. Scripture, some Work on Statistics. Isaac Ott, the Location of the Cerebral Motor Center of the Bladder. F. S. Lee, the Sense of Equilibrium in Fishes. J. W. Warren, a Finger Jerk. H. P. Bowditch, on Muscular Rigor. H. P. Bowditch, on the Effect of varying Rates of Interruption in Nerve. W. H. Howell, the relations of Calcium Salts to the irritability of the Muscle and Nerve. G. Lusk, the Influence of ingested Sugars in Phlorizin Diabetes. P. A. Levene, Preliminary Communication; the Blood in Phloridzin Diabetes. H. E. Smith, Acidity of the Urine. W. Gilman Thompson, Notes on the Physiological Effect of Ozonizing Agents.

The following demonstrations were given: S. J. Meltzer, Demonstration of a Pleura canula. W. G. Thompson, Demonstration of inexpensive Models for teaching purposes. A. P. Brubaker, Demonstration and Determination of the Radius of the Corneal Curvature with the Opthalmometer. W. P. Lombard, Model, showing Effect of Rotation of Ribs.

THE GEOLOGICAL SOCIETY OF AMERICA met in Boston, Dec. 27th and 29th, 1893. The following is a list of papers read before it:

Sir J. William Dawson, some recent discussions in geology (Presidential address). George M. Dawson, Geological notes on some of the coasts and islands of Behring Sea and its vicinity. Frank H. Knowlton, Fossil flora of Alaska. Sir J. William Dawson, New discoveries of Carboniferous Batrachians. William H. Dall and Joseph Stanley-Brown, Cenozoic geology along the Apalachicola river. Alfred C. Lane, Geological activity of the earth's originally absorbed gases. William B. Clark, Certain climatic features of Maryland. H. S. Williams, Dual nomenclature in geologic classification. George Huntington Williams, Johann David Schoepff, and his contributions to North American Geology. Bailey Willis, Relations of synclines of deposition to ancient shorelines. Alexander Agassiz, an

account of an expedition to the Bahamas. William B. Scott, Lacustrine Tertiary formation of the west. C. Willard Hayes, Geology of the Coosa valley in Georgia and Alabama. William H. Hobbs, Geological structure of the Housatonic valley lying east of Mt. Washington; read by J. E. Wolff. J. E. Wolff, the Hibernia fold, New Jersey. N. S. Shaler, Tertiary dislocation of the Atlantic coast of the United States. N. S. Shaler, relations of mountains to continents. N. S. Shaler, Phenomena of beach and dune sands. W. M. Davis and L. S. Griswold, Eastern boundary of the Connecticut Triassic. W. M. Davis, Geographical work for state geological surveys. W. M. Davis, Facetted pebbles on Cape Cod. Charles D. Walcott, Paleozoic intra-formational conglomerates. M. R. Campbell, Paleozoic overlaps in Montgomery and Pulaski counties, Virginia. Alpheus Hyatt, the Trias and Jura of the Western States. J. S. Diller, the Shasta-Chico series of the Pacific coast. T. W. Stanton, the Cretaceous faunas of the Shasta-Chico series. Robert T. Hill, Geology of Indian Territory and Texas adjacent to Red river. S. F. Emmons and G. P. Merrill, Notes on the geology of Lower California. William B. Clark, Origin and classification of the greensands of New Jersey. Charles R. Keyes, Crustal adjustment in the upper Mississippi basin. William H. Niles, a geological study of Lake Mohonk and Lake Minnewaska, N. Y. N. H. Darton, Geologic relations in the belt from Green Pond, New Jersey, to Skunnemonk Mountain, New York. Robert H. Richards, a prismatic stadia telescope. George Huntington Williams, Ancient volcanic rocks along the eastern border of North America. C. H. Hitchcock, Ancient eruptive rocks in the White Mountains. G. K. Gilbert, the chemical equivalence of crystalline and sedimentary rocks. William H. Hobbs, Volcanite, an anorthoclase augite rock chemically like the dacites read by G. H. Williams. H. P. H. Brumell, Further notes on the occurrence of labertite in New Brunswick, Canada. Homer T. Fuller, Alterations of silicates in gneiss at Worcester, Mass. Robert Bell, Pre-paleozoic decay of crystalline rocks north of Lake Huron. James F. Kemp, Gabbros on the western shore of Lake Champlain. Robert W. Ells, Notes on the occurrence of mica in the Laurentian of the Ottawa district. Whitman Cross, Intrusive sandstone dikes in granite. James P. Smith, Age of the auriferous slates in the Sierra Nevada. William O. Crosby, Origin of the coarsely crystalline vein granites or pegmatites. William O. Crosby, a classification of economic geological deposits, based upon origin and original structure. R. S. Tarr, Lake Cayuga a rock basin. James E. Todd, Plistocene problems in

Missouri. G. Frederick Wright, Remarks upon a supposed glaciated stone axe from Indiana. T. C. Chamberlin, Pseudo-cols. T. C. Chamberlin and Frank Leverett, Certain features of the past drainage systems of the upper Ohio basin. G. Frederick Wright, Glacial history of western Pennsylvania. F. B. Taylor, the ancient strait at Nipissing. Edward H. Williams, Extramoraine drift between the Delaware and the Schuylkill. Professor Dr. Alfred Teutzsch, Königsberg, Prussia, Interglacial series of Germany. Warren Upham, the Madison type of drumlins. Warren Upham, Diversity of the glacial drift along its boundary. E. O. Hovey, Notes on the microscopic structure of siliceous oölite.

Indiana Academy of Science.—The Ninth Annual Meeting was held at Indianapolis, December 28 and 28, 1893, when the following papers relating to Natural History were read and discussed:

An Alphabetical and Synonymical Catalogue of the Acrididæ of the United States, W. S. Blatchley. On the Hibernation of Turtles, A. W. Butler. Some Notes on a Variety of *Solanum dulcama*, R. Wes. McBride, Work of the Botanical Division of the Natural History Survey of Minnesota, D. T. MacDougal. Indiana Fishes, C. H. Eigenmann. The Fishes of Wabash County, A. B. Ulrey. Review of Botanical Work in Indiana with Bibliography, L. M. Underwood. Notes on an Imbedding Material, John S. Wright. Recent Notes on Indiana Birds, A. W. Butler. The Distribution of Indiana Birds, A. W. Butler. On the Occurence of the Rarest of the Warblers (*Dendroica kirtlandii*) in Indiana, A. B. Ulrey. Histology of the Pontederiaceæ, E. W. Olive. Growth in Length and Thickness of the Petiole of Richardia, Katherine E. Golden. The Geographical and Hypsometrical Distribution of North American Viviparidæ, R. Ellsworth Call. The Effect of Light on the Germinating Spores of Marine Algæ, Melvin A. Brannon. Notes on Saprolegnia, George L. Roberts. Contributions to the Life-History of Notothylas, D. M. Mottier. Some South American Characinidæ, with Six New Species, A. B. Ulrey. Should the Study of Natural Science in the Lower Classes of the Public Schools be Encouraged, W. W. Norman. The Detection of Strychnine in an Exhumed Human Body, W. A. Noyes. Absorption of Poisons by Animal Tissue After Death, P. S. Baker. Induration of Certain Tertiary Rocks in North-Eastern Arkansas, R. Ellsworth Call. The White Clays of Southern Indiana, A. W. Butler. The Effect of Environment on the Mass of Local Species, C. H. Eigenmann. The Ash of Trees, Mason B. Thomas. Poisonous Influence

of *Cypripedium spectabile*, D. T. MacDougal. Notes on the Biological Survey, Mason B. Thomas. Notes on Sectioning Woody Tissues, John S. Wright. The Stomates of Cycas, Mason B. Thomas. Symbiosis in *Isopyrum biternatum*, D. T. MacDougal. Our Present Knowledge of the Distribution of Pteridophytes of Indiana, Lucien M. Underwood. Concerning the Effect of Glycerine on Plants, John S. Wright. The Adventitious Plants of Fayette County, Robert Hessler. Bibliography of Indiana Ornithology, A. W. Butler. Bibliography of the Batrachians and Reptiles of Indiana, O. P. Hay. Bibliography of Indiana Mammals, A. W. Butler and B. W. Everman

The President's address by Dr. J. C. Arthur discussed "The special senses of plants."

NATURAL SCIENCE ASSOCIATION OF STATEN ISLAND, Nov. 11th, 1893. Mr. William T. Davis exhibited specimens of *Anodonta fluviatilis* Lea, and read the following memorandum:

Rediscovery of Anodonta fluviatilis on Staten Island.—During the past summer *Anodonta fluviatilis* was found in the Bull's Head pond. Only empty shells were discovered, chiefly such as had been opened and their contents eaten by musk rats. Mr. Sanderson Smith has informed me that, as far as he remembers, the specimens admitted into the list of fresh and salt water shells of the Island, originally published in the Annals of the New York Lyceum of Natural History, in May, 1865, and subsequently republished with a few changes, in our Proceedings, as Extra No. 5, March, 1887, came from the ponds near Clifton. None have been reported in many years, so the present specimens from Bull's Head are worthy of being placed on record.

Mr. Arthur Hollick exhibited specimens of drift bowlders, containing fossils, from Prince's Bay, and read the following memorandum:

A Recent find of Drift fossils at Prince's Bay.—On the 29th of last month, while examining the Drift rocks at the base of the Prince's Bay bluff, I found four bowlders containing fossils, representing four different geological horizons, viz.: Hudson shale, with *Orthis*, probably *O. testudinaria* Dal; Helderberg limestone, with *Strophodonta beckii* Hall, *S. varistriata* Conr. *Strophomena rhomboidalis* Wahl. and *Orthis oblata* Hall; Oriskany sandstone, *Spirifera arrecta* Hall; Schoharie grit, with *Atrypa reticularis* L. and fine specimens of some Bryozoon not determined. By far the larger part of the bowlders was left behind and will receive further attention on some future occasion. These do not add any new species to our already published lists of Drift

fossils, except in the case of the provisionally determined *Strophodonta varistriata*, but the discovery, in one day, in a very limited area, of four fossiliferous bowlders, representing as many different geological horizons, is perhaps worthy of note.

THE BIOLOGICAL SOCIETY OF WASHINGTON, Jan. 13, 1894.—Communications: Dr. Theo. Gill, the Segregation of the Osteophysarial Fishes as Fresh water Forms. Mr. Robt. T. Hill, a new Fauna from the Cretaceous Formations of Texas. Dr. C. W. Stiles, the Teaching of Biology in Colleges. Mr. J. N. Rose, a Botanical trip to Northwestern Wyoming.

SCIENTIFIC NEWS.

The death is announced at Paris of the biologist Dr. Chabry, known for his work in experimental teratology.

M. Paul Fischer, the conchologist of the Museum d'Histoire Naturelle, died Nov. 29, 1893. He contributed largely to the literature of science, his Histoire des Mollsques du Mexique being, perhaps, the best known of his works.

Dionys Stur, late director of the K. K. geologische Reischsanstalt of Austria, died at Vienna, Oct. 9th, 1893.

The loss to zoology by the recent death of Prof. Milnes Marshall, of Owens College, Manchester, England, is not easily estimated. There is a striking similarity in the manner of his death and that of his instructor, the lamented. Marshall was climbing one of the peaks ef Scfeawll, in Cumberland, when his foot slipped, and he fell over a precipice. His death occurred June 31, 1893.

A prize of 1,800 francs is offered by the Italian Geological Society for the best memoir on the present knowledge of the paleozoic and mesozoic formations in Italy. This paper will follow one by D'Archiac entitled " History of the Progress of Geology ", and must be presented before the end of March, 1896.

Dr. Harrison Allen has been appointed director of the Wistar Institute of Anatomy of the University of Pennsylvania.

The Owen's Memorial Committee has entrusted the statue of the late Sir Richard Owen to Mr. T. Brock, R. A.

The late Professor Newberry's name is to live in a fund which the scientific societies of New York have resolved to raise, It will be called the John Strong Newberry fund, be not less than $25,000, and the income derived from it will be devoted to the encouragement of scientific work in geology, paleontology, botany and zoology. Professor N. L. Britton is secretary to the subscription committee.

Professor Ben. K. Emerson, of Amherst College, and of the U. S. Geol. Surv., who met with a serious railway accident last summer, and was reported killed, has so far recovered that he has started on a trip around the world for rest and recuperation. He visits Italy, Egypt, India, Java and Japan. Prof. Emerson has been engaged for a long time in mapping the crystalline rocks of Central Massachusetts and Connecticut.

A member of the Anthropological Society of Washington has placed in the hands of the Treasurer of the Society a sum of money to be awarded in prizes for the clearest statements of the elements that go to make up the most useful citizen of the United States, regardless of occupation. The donation has been accepted, and the Society has provided for the award of the following prizes during the present year (1893) under the following conditions:

Two prizes will be awarded for the best essays on the subject specified above, viz: A first prize of $150 for the best essay, and a second prize of $75 for the second best essay among those found worthy by the commissioners of award.

These prizes are open to competitors in all countries.

Essays offered in competition for the prizes shall not exceed 3,000 words in length, and all essays offered shall be the property of the Anthropological Society of Washington, the design being to publish them at the discretion of the Board of Managers, in the official organ of the Society, the *American Anthropologist*, giving due credit to the several authors.

Each essay should bear a pseudonym or number, and should be accompanied by a sealed envelope bearing the same pseudonym or number, and containing the name and address of the competitor; and the identity of the competitors shall not in any way be made known to the Commissioners of Award.

Essays must be type-written or printed, and must be submitted not later than November 1, 1893. [Since changed to March 1, 1894].

THE

AMERICAN NATURALIST

VOL. XXVIII. March, 1894. 327

THE ENERGY OF EVOLUTION.

BY E. D. COPE.

1 PRELIMINARY.

In considering the dynamics of organic evolution, it will be convenient to commence by considering the claims of Natural Selection to include the energy which underlies the process. That Natural Selection cannot be the cause of the origin of new characters, or variation, was asserted by Darwin;[1] and this opinion is supported by the following weighty considerations.

(1) A selection cannot be the cause of those alternatives from which it selects. The alternatives must be presented before the selection can commence.

(2) Since the number of variations possible to organisms is very great, the probability of the admirably adaptive structures which characterize the latter having arisen by chance is extremely small.

(3) In order that a variation of structure shall survive, it is necessary that it shall appear simultaneously in two individuals of opposite sex. But if the chance of its appearing in one individual is very small, the chance of its appearing in two individuals is very much smaller. But even this concurrence of chances would not be sufficient to secure its survival, since it would be immediately bred out by the immensely prepon-

---

[1] Origin of Species, Ed. 1872, p. 65.

derant number of individuals which should not possess the variation.

(4) Finally, the characters which define the organic types, so far as they are disclosed by paleontology, have commenced as minute buds or rudiments, of no value whatsoever in the struggle for existence. Natural Selection can only effect the survival of characters when they have attained some functional value.

In order to secure the survival of a new character, that is, of a new type of organism, it is necessary that the variation should appear in a large number of individuals coincidentally and successively. It is exceedingly probable that that is what has occurred in past geologic ages. We are thus led to look for a cause which affects equally many individuals at the same time, and continuously. Such causes are found in the changing physical conditions that have succeeded each other in the past history of our planet, and the changes of organic function necessarily produced thereby.

2 BATHMOGENESIS.

If we view the phenomena of organic life from the standpoint of the physicist, the first question that naturally arises in the mind is as to the kind of energy of which it is an exhibition. Ordinary observation shows that organic bodies perform molar movements, and that many of them give out heat. A smaller number exhibit emanations of light and electricity. Very little consideration is sufficient to show that they include among their functions chemical reactions, a conviction which is abundantly sustained by researches into the physiology of both animals and plants. The phenomena of growth are also evidently exhibitions of energy. The term energy is used to express the motion of matter, and the building of an embryo to maturity is evidently accomplished by the movement of matter in certain definite directions. The energy which accomplishes this feat is, however, none of those which characterize inorganic matter, some of which have just been mentioned, but, judging from its phenomena, is of a widely different character. If we further take a broad view of the general

process of progressive evolution, which is accomplished by successive modifications of this growth-energy, we see further reason for distinguishing it widely from the inorganic energies.

It is customary to distinguish broadly between inorganic and organic energies, as those which are displayed by non-living and living bodies. This classification is inexact, since, as already remarked, nearly all of the inorganic energies are exhibited by living beings. A division which appears to be, with our present knowledge, much more fundamental, is into the energies which tend away from, and those which tend towards, the phenomena of life. In other words, those which are not necessarily phenomena of life, and those which are necessarily such. And the phenomena of life here referred to are the phenomena of growth and evolution, as distinguished from all others. I have termed[2] these classes the Anagenetic, which are exclusively vital, and the Catagenetic, which are physical and chemical. The Anagenetic class tends to upward progress in the organic sense; that is, toward the increasing control of its environment by the organism, and toward the origin and development of consciousness and mind. The Catagenetic energies tend to the creation of a stable equilibrium of matter, in which molar motion is not produced from within, and sensation is impossible. In popular language the one class of energies tends to life; the other to death.

That the Catagenetic energies whether physical or chemical, tend away from life is clear enough. Thus molar motion unless continuously supplied, or directed by a living source, speedily ceases, being converted by friction into heat, which is dissipated. And were we to suppose a case where friction is non-existent, motion would remain molar, and no phenomena of organic life would result, and sensation could not arise. The same is true of molecular movements under the same conditions. Chemical reactions, which are fundamental in world-building, result in the production of solids and the radiation of heat. The most familiar example, that of oxydation, presents us with the case of a gas becoming a liquid

[2] The Monist Chicago, 1893, p. 680.

or a solid with the evolution of heat. The endothermic reaction, where matter undergoes a change of molecular aggregation the reverse of that just mentioned, with the absorption of heat, as in the case of several hydrogen compounds, is rare in nature, where free from organic complications, and is generally soon reversed by further reactions. Finally cosmic creation involves the perpetual radiation of heat into space, and the gradual reduction of all forms of matter to the solid state.

In the anagenetic energies, on the other hand, we have a process of building machines, which not only resist the action of catagenesis, but which press the catagenetic energies into their service. In the assimilation of inorganic substances they elevate them into higher, that is more complex compounds, and raise the types of energy to their own level. In the development of molar movements they enable their organisms to escape many of the destructive effects of catagenetic energy, by enabling them to change their environment; and this is especially true in so far as sensation or consciousness is present to them. The anagenetic energy transforms the face of nature by its power of assimilating and recompounding inorganic matter, and by its capacity for multiplying its individuals. In spite of the mechanical destructibility of its physical basis (protoplasm), and the ease with which its mechanisms are destroyed, it successfully resists, controls, and remodels the catagenetic energies for its purposes.

The anagenetic power of assimilation of the inorganic substances is chiefly seen in the vegetable kingdom. Atmospheric air, water and inorganic salts furnish it with the materials of its physical basis. Then from its own protoplasm it elaborates by a catagenetic retrograde metamorphosis, the mostly non-nitrogenous substances, as wood (cellulose), waxes, oils and alkaloids, and it may take up inorganic substances and deposit them without alteration in its cells. Many of the compounds elaborated by plants and animals have been manufactured of latter time by chemists. The discovery that the living organism is not necessary for the production of these substances has led to the hasty conclusion that the supposed distinction between "organic" and "inorganic" energy does not exist. But the

elaboration of these substances is not accomplished by anagenetic or "vital" energy, but by a process of running down of the higher compound protoplasm, which is catagenesis. No truly anagenetic process has yet been imitated by man.

All forms of functioning of organs, except assimilation, reproduction and growth, are catagenetic. That is, functioning consists in the retrograde metamorphosis of a nitrogenous organic substance or proteid with the setting free of energy. The proteid is decomposed in the functioning tissue into carbon dioxyd, water, urea, etc., and energy appears in the muscle as contraction, in the glands as secretion, and in all parts of the body as heat. The general result of physiologic research is, that the decomposition of the blood is the source of energy, while the tissue of each organ determines the character of that energy. That the tissue itself suffers from wear, and requires repair, is also true, but to a less extent than was once supposed.

In the anagenetic process of the growth of the embryo the case is different. Here the processes of functioning of organs are in complete abeyance, the nutritive substance is not entirely broken down in chemical decomposition, but it is in great part elaborated into tissues and organs. All the mechanisms necessary to the mature life of the individual are constructed by the activity of the special form of energy known as growth-energy or Bathmism. It is the modifications of this energy which constitute evolution, and it is these to which we will hereafter direct our attention. Its simplest exhibition is the subdivision of a unicellular protoplasmic body into two or more individuals or structural units of a multicellular organism. Further division of the latter does not abolish the individual, but extends it, and we now observe the elaboration of different structural types to become a conspicuous function of this form of energy. In other words a once simple energy becomes specialized into specific energies, each of which, once established, pursues its mode of motion in opposition to all other modes not more potent than itself. Besides the evident truth of the proposition than a mode of building is a mode of motion, we have another very good reason for believing in the existence

of a class of bathmic or growth-energies. This is found in the phenomena of heredity. The most rational conception of this inheritance of structural characters is the transmission of a mode of motion from the soma to the germ-cells. This is a far more conceivable method than that of the transmission of particles of matter, other than the ordinary material of nutrition. The bathmic theory of heredity bears about the same relation to a theory of transmission of the pangenes of Darwin, or the ids of Weismann, as the undulatory theory of light and other forms of radiant energy does to the molecular theory of Newton. I have therefore assumed as a working hypothesis the existence of the bathmic energy, and will enquire how far the facts in our possession sustain it. In doing so it will be necessary to elaborate the theory so as to render clearer its application to specific cases. The fact to be accounted for is its specialization into so many diverse specific forms.

A further indication of the existence of the bathmic energy is the quantitative limitation to which growth is obedient. Thus the successive stages of embryonic growth are limited in number in each species. The dimensions of many species are limited within a definite range. The duration of life, or of the functioning organic machine, has a definite limit in time. All this means that a certain limited quantity of energy is at the disposal of each individual organism.

In "The Origin of the Fittest," I have endeavored to show what causes have been and are efficient in the production of different types of organic life, through the modifications of the bathmic energy. We will now briefly consider to the question of the origin of the living substance, protoplasm or sarcode, which exhibits bathmism.

If the tendency of the catagenetic energies is away from vital phenomena, it is impossible that they, or any one of them, should be the cause of the origin of living matter. This logical inference is confirmed by the failure of all attempts to demonstrate spontaneous generation of living organisms from inorganic matter. Further, the principle of continuity leads us to infer that the energy which produced organic matter must be identical with or allied to that which is the efficient agent in pro-

gressive evolution of organisms, and is, therefore, anagenetic. Such a conclusion may seem to lead to a dualism which is itself opposed to the principle of continuity or uniformity, and which is opposed to experience of the phenomena of energy in general. How is uniformity to be harmonized with the hypothesis of two types of energy acting in different directions, apparently in opposition to each other? Since facts and logic do not support the derivation of the anagenetic from the inorganic energies, can the reverse process, the derivation of the catagenetic from the anagenetic be and have been the order of nature? In support of this hypothesis, we have the universal prevalence of the retrograde metamorphosis of energy in both the inorganic and organic kingdoms. Phenomena of structural degeneracy are well known in the organic world, and purely chemical phenomena in both organic and inorganic processes are all degenerate. It appears then much more probable that catagenesis succeeds anagenesis as a consequence, and does not precede it as a cause. In other words, it is more probable that death is a consequence of life, rather than that the living is a product of the non-living. I have therefore given to that energy which is displayed by the plant in the elaboration of living from now living matter the name of antichemism.[3] Thus while the heat of the sun is necessary to the building of protoplasm, within a certain range of temperature, this form of energy has its opportunity.

In order to present more clearly the views enunciated in the preceding pages, I give a synoptic table of energies.

I Anagenetic	Organic	Antichemism. Bathmism.
II Catagenetic	Exclusively organic	Neurism. Myism.
	Inorganic	Radiant Energy. Chemism. Cohesion. Gravitation.

3 THE FORMS OF BATHMISM.

The innumerable structures which are due to the activity of Bathmisms may be supposed to result from the composition of

---

[3] American Naturalist, 1884, p. 979. Origin of the Fittest, 1887, p. 431.

this energy with others which are present in the organism or in the environment, or both. Ryder has called the exhibition of growth energy Ergogenesis,[4] and he calls attention to the fact that it appears under two aspects. In the first, Ergogenesis is due to mechanical causes resident in the organism exclusively, and it expresses the sum of the bathmic energy inherited from the parents of the growing organism. To this conservative expression of Bathmism he gives the name of Statogenesis. In the second aspect of Ergogenesis, the course of growth (ontogeny) is determined by motion from sources external to the germ cell. It is this which modifies ontogeny and produces those changes of structure which constitute Evolution. To this aspect of growth I have given the name Kinetogenesis.[5] As Statogenesis expresses simple growth force, and Kinetogenesis the additional growth, which is evolution, the latter is chiefly considered here.

Kinetogenesis is of two kinds; viz., the changes in growth which are due to the interference of molecular energies only, and those which are due to molar movements. The former type of evolutionary growth I propose to call Physiogenesis; and I propose to restrict the term kinetogenesis to the latter class. To the total evolutionary energy or energies due to external interference, the Kinetogenesis of Ryder, I propose to apply the term Bathmogenesis. The relation of these modes, and their corresponding names may be expressed as follows:

$$\text{Ergogenesis}\begin{cases}\text{Statogenesis}\\ \text{Bathmogenesis.}\begin{cases}\text{Physiogensis.}\\ \text{Kinetogenesis.}\end{cases}\end{cases}$$

Statogenesis, I shall hereafter endeavor to show, is an automatic product of Bathmogenesis.

The first step in the order of Bathmogenetic action is the effect of stimuli on an animal which is no longer protected by the parent or by parental products (egg-shell) as an embryo. Changes may be effected in the weight, color, and in functional

---

[4] Proceeds. Amer. Philos. Soc. 1893, p. 194.

[5] Origin of the Fittest, 1887, p. 423. Statogenesis and Kinetogenesis are the equivalents of my Growth Force and Grade Growth Force, Proceeds. Amer. Philos. Soc. 1871, p. 258.

capacity by temperature, humidity, food, etc., thus exhibiting physiogenesis. Or changes in the size and form of parts of the body may be produced by movements of the organism, or of its environment, so displaying Kinetogenesis. So long as these modifications of structure should be confined to the individuals thus modified, there would be no evolution. A second generation, if not subjected to the same stimuli, would not possess the modifications; and their possession of them would depend entirely on the amount of stimulus. In other words there would be no accumulation of modification. It has, however, been generally believed that these modifications are inherited, and I think it can be shown that this belief rests on a solid basis. Meanwhile I call the Bathmogenesis which does not extend beyond the generation in which it appears, autobathmogeny.

The quantitative relation which necessarily exists between Bathmism and its sources may be expressed as follows, with due recognition of the fact that such expression does not rest upon any experimental tests. Statogenesis is work done in the construction of tissues like those of the parent and without interference. Here we have the molecular energy of the parent (either as protozoon or oösperm) temporarily converted in part into the molar movements observed to be concomitants of segmentation; to be represented in the completed tissue by the mutual tensions by virtue of which each structural element maintains its integrity. It is evidently a process of metamorphosis of energy in which there is less waste than in any other known to us. Embryonic growth is accompanied by a very slight dissipation of heat, though a slight rise of temperature is noticeable in the eggs of cold-blooded animals and in flowers, when reproduction is active. The products of breaking down are equally rare in embryonic growth, and both this and the dissipation of heat are evidently largely due to the changes wrought in non-cleavable nutritive substances with which the yolks are sometimes charged. It is probably to accomplish this process that the oxygen necessary for the embryonic growth is used. How much loss is due to cell division itself

is not known, but it must be very little if any. We have here a nearly perfect conversion of energy. Theoretically we have anagenesis wherever the up-building exceeds the down-breaking.

The attempt to realize in the imagination the modus operandi of bathmic energy in embryo building takes the following form. It is to be supposed that movement which has been most frequently repeated, and for the longest period, is prepotent, and takes precedence of all others. This is clearly simple cell division, which follows the nutrition supplied by the spermatozoön, and which represents the first act of animal life. Hence, segmentation of the oösperm is the first movement of bathmism. Each subsequent movement appears in the order of potency, which is, other things being equal, a time order, or the order of record. The cause of the localization of tissues and structures is much more difficult to understand than the cause of the order of their appearance. The more energetic part of the process naturally requires the greater space for its products. The ectoderm, which becomes the seat of the nervous axis and its muscular adjuncts, occupies the superficial portions of the yolk. Hence, we may regard this expression of the structural record of these functions as more energetic than that of the record structure of the nutritive functions, which displays itself below the ectoderm. In meroblastic and amphiblastic embryos, the segmentation which develops the nutritive tissues is evidently more sluggish, for the cells are larger and fewer in number than those of the ectoderm.

Can this difference in the segmentations which produce the ectoderm and the endoderm be due to a certain polarity; the male or energetic tendency predominating in the former, and the female in the latter?

External stimuli modify the course of statogeny above described, and by producing new structural records cause a new form of energy, due to composition of the new with the old, and the process of growth then becomes bathmogeny. The external stimuli are molecular or molar, determining physiobathmism or kinetobathmism.

The effect of motion or use on the soma may be conveniently termed autokinetogenesis. Moderate use of a muscle is known to increase its size. Irritation of the periosteum is known to cause deposit of bone. Friction and pressure of the epithelium increases its quantity or changes its form. Increased activity of the functions of nervous tissues increases their relative proportions, as in the enlargement of nerves which replace others which are interrupted by mutilations, etc. On the other hand, it is equally well known that disuse produces diminution of muscular tissue, and through it, a reduction in the quantity of the harder tissue (bone, chitin, etc.) to which it is attached, (as muscular insertions, etc.). It was the observation of such well-known phenomena as these that led Lamarck to advance his doctrine of evolution under use and disuse, and which has led many others to give their adherence to such a view.

Thus much for cell-growth. Another class of modifications of a similar kind may be found in the parts of an organism which consist of a complex of cells, or tissues. Thus the lumen of a small artery is enlarged under the influence of pressure when it is compelled to assume the function of a larger vessel through the interruption of the latter. A part of an internal or external skeleton which is fractured will form an artificial joint at the point of fracture, if the adjacent surfaces are kept in motion. Marey (Animal Mechanism pp. 88–89) says " After dislocations the old articular cavities will be filled up and disappear, while at the new point where the head of the bone is actually placed, a fresh articulation is formed, to which nothing will be wanting in the course of a few months, neither articular cartilages, synovial fluid, nor the ligaments to retain the bone in place." I have given some illustrations of this fact,[6] which have come under my observation, and which have an important bearing on the origin of the articulations of the vertebrate skeleton as I have traced them throughout geological time. I have as I think conclusively shown that these varied structures have been produced by impacts and strains, which are concomitants of the movements of the animals, acting through long periods of time.[7] I have also proposed the

[6] Proceeds. Amer. Philos. Soc. 1892, p. 285.

[7] Mechanical Origin of the Hard parts of the Mammalia, Amer. Journal of Morphology, 1889. Origin of the Fittest, 1887, pp. 305-373.

hypothesis, that such Kinetogènetic organic energies as are not under the control of the organism, are the product of the catagenesis of energies which were at one time under such control.

4 MNEMOGENESIS.

The above term is employed by Prof. Hyatt[8] to characterize the manner in which kinetogenesis is supposed to produce results in inheritance. I have suggested that the phenomena of recapitulation, characteristic of ontogeny (Amer. Naturalist, Dec., 1889), are due to the presence of a record in the germ cells, having a molecular basis similar to that of memory. This view is adopted by Professor Hyatt. I have already referred to it in the preceding pages. The stimuli which are thus recorded are those which produce growth effects in the body or soma, so that each stimulus may have a double influence. For this reason I have termed this theory of the distribution of energy, Diplogenesis (loc. cit.).

The first statement of the mnemonic theory of heredity which I can discover, is that made by Hering in 1870.[9] It is concentrated in the following paragraph: "The appearance of properties of the parental organism in the full-grown filial organism can be nothing else but the reproduction of such processes of organized matter as the germ when still in the germinal vesicles had taken part in; the filial organism remembers, so to speak, those processes, as soon as an occasion of the same or similar irritations is offered a reaction takes place as formerly in the parental organism, of which it was then a part and whose destinies influenced it." In explanation of this theory Hering says: "We notice, further on, that the process of development of the germs which are destined to attain an independent existence, exercises a powerful reaction upon both the conscious and unconscious life of the whole organism. And this is a hint that the organ of germination is in closer and more momentous relation to the other parts, especially to the nervous system, than another organ. In an inverse ratio the conscious and unconscious destinies of the whole organism,

---

[8] Proceeds. Boston Soc. Nat. Hist. 1893, p. 73.

[9] Address befoie the Imperial Academy of Sciences of Vienna, May 30, 1870, by Edwald Hering.

it is most probable, find a stronger echo in the germinal vesicles than elsewhere."

It is evident that evolutionists are reaching greater harmony of opinions on the question of inheritance, for both sides are adopting the doctrine of Diplogenesis. In fact, the discussion is beginning to be a logomachy dependent on the significance which one attaches to the term, "acquired characters." Thus, Vom Rath, who says he does not believe in the inheritance[10] of acquired characters, remarks: "there is nothing in the way of the opinion that by the continual working of such external influences and stimuli, the molecular structure of the germ-plasma also experiences a change which can lead to a transmission of transformations. Above all, it ought not to be forgotten in this case that the somatic cells are in no way the first to be modified by the stimulus, and that then by some sort of unexplained process (pangenesis or intercellular pangenesis) this stimulus is transmitted generally by these cells to the plasma of the germ cells. The influence on the germ-plasma is rather a direct one, and if by continued influence a transformation of the structure of this plasma takes place and transmission occurs, we have then simply a transmission of blastogenic and by no means of somatogenic characters, and therein is not the slightest admission of the transmission of acquired characters."

This surprising paragraph contains an admission of the doctrine of Diplogenesis, and does not regard the phenomena as including a transmission of acquired characters. Nevertheless, the stimuli traverse the soma in order to reach the germ plasma. Such an energy is evidently then not of blastogenic origin, although it is such in its effects. Moreover, Vom Rath omits to mention the fact that in traversing the soma, the stimulus frequently, if not always, produces effects on the latter similar to those which it produces on the germ plasma. I should call this process the inheritance of an acquired character, even in the case where no corresponding modification appears in the soma, since the causative energy is acquired by the soma, and is not derived from the existing germ plasma.

---

[10] Berichte der Naturforsch. Gessel. zu Freiburg Baden. Bd. VI, H. 3.

Romanes[11] says, in revising the opinions of Weismann, "(1) Germ Plasm ceases to be continuous in the sense of having borne a perpetual record of congenital variations from the first origin of sexual propagation. (2) On the contrary, *as all such variations have been originated by the direct action of external conditions*" (italics mine) "the continuity of the germ plasm in this sense has been interrupted at the commencement of every inherited change during the phylogeny of all plants and animals, unicellular as well as multicellular. (3) But germ plasm remains continuous in the restricted though highly important sense of being the sole repository of hereditary characters of each successive generation, so that acquired characters can never have been transmitted to progeny, 'representatively,' even though they have frequently caused those 'specialized' changes in the structure of the germ plasm, which, as we have seen, must certainly have been of considerable importance in the history of organic evolution."

Here the inheritance of characters acquired by the soma is admitted, and the process is after the method of Diplogenesis. According to Romanes, Galton originally propounded this doctrine. Galton's language[12] is as follows:

"It is said that the structure of an animal changes when he is placed under changed conditions; that his offspring inherit some of his change, and that they vary still further on their own account, in the same direction, and so on through successive generations until a notable change in the congenital characteristics of the race has been effected. Hence, it is concluded that a change in the personal structure has reacted on the sexual elements. For my part, I object to so general a conclusion for the following reasons. It is universally admitted that the primary agents in the processes of growth, nutrition and reproduction, are the same, and that a true theory of heredity must so regard them. In other words, they are all due to the development of some germinal matter variously located. Consequently, when similar germinal matter is everywhere affected by the same conditions, we should

---

[11] An Examination of Weismannism, Chicago, 1892, p. 169.

[12] Contemporary Review, 1875, pp. 343–4; Proceeds. Royal Soc., 1872, no. 136.

expect that it would be everywhere affected in the same way. The particular kind of germ whence the hair sprang that was induced to throw out a new variety in the cells nearest the surface of the body under certain changed conditions of climate and food, might be expected to throw out a similar variety in the sexual elements at the same time. The changes in the germs would everywhere be collateral, although the moments when any of the changed germs happen to receive their development might be different." This is the first statement of the doctrine of Diplogenesis with which I have met and it appears to me to furnish the most rational basis for the investigation into the dynamics of the process.

THE CLASSIFICATION OF THE ARTHROPODA.

BY J. S. KINGSLEY.

(*Continued from page* 135, *February, 1894.*)

SUB-CLASS II—EUCRUSTACEA.

Crustacea, with filiform, plumose or lamellate gills, in either thoracic or abdominal region; mouth parts never ambulatory in the adult, but modified for the prehension and comminution of food. Nauplius stage either free-swimming or passed in the egg.

It is difficult, with our present knowledge, to find good diagnostic points separating the true Crustacea from the Trilobites, and it may be that further research will show that the latter are to be regarded as a division equivalent to some of those mentioned below. At present, the arrangment of the feet of the cephalic region in a circle around the mouth, the use of their basal joints for the comminution food, and the apparent functioning of the distal joints as locomotor organs, together with the peculiar gills, must serve to differentiate the two groups, it being understood that the ideas here expressed are merely provisional.

In the sub-division of the Crustacea I am inclined to adopt the recent "sub-classes" of Grobben ('92) as super-orders as follows:

Super-Order I, Phyllopoda.
  Order I, Euphyllopoda.
  Order II, Cladocera.
Super-Order II, Estheriæformes.
  Order I, Ostracoda.
Super-Order III, Apodiformes.
  Order I, Copepoda.
  Order II, Cirripedia.
Super-Order IV, Malacostraca sive Branchipodiformes.

I, Leptostraca.
Order I, Nebaliadæ.
II, Eumalacostraca.
Order I, Stomatopoda.
Order II, Thoracostraca.
Order III, Arthrostraca.

On the whole, I accept the conclusions of Grobben as to the relationships of the various groups, and have, like many other zoologists, regarded the Phyllopods as the ancestral stock. I think that this is shown by, among other points, the structure of the appendages, regarding which I fully accept the conclusions of Lankester[2] ('81). I do not regard the nauplius stage as indicative of a naupliform ancestor, but as an introduced feature, for which view the arguments adduced by Claus and Dohrn, seem valid. The ancestor of the Phyllopods must have been an elongate poly-somitic animal with lamellate appendages, the basal portions of one or more "legs" serving at the same time as both locomotor and manducatory organs. In short, my views as to the ancestral form are much like those adopted by Bernard ('92), although I cannot accept all of his conclusions as to the steps of the evolution.

CLASS II—ACERATA.

Branchiate Arthropods, in which the branchial folds, developed from the abdominal appendages function as gills, as lungs, or as tracheæ. The body is divided into cephalothorax and abdomen, the line passing behind the sixth pair of appendages. The genital ducts open upon the first abdominal somite. The anterior postoral ganglia unite to form a ganglionic ring around the œsophagus; the median eyes are in-

---

[1] I regard Packard's ('87) Syncarida as a group of Amphipoda of scarcely more than family rank.

[2] Grobben does not accept Lankester's views, and claims that embryology shows that Lankester's sixth endite is the endopodite and the flabellum the exopodite, in support of which he cites the observations of Claus ('73, p. 20). I cannot find there or anywhere else in Claus' paper any evidence which is not capable of being interpreted in full harmony with Lankester's view that the 5th and 6th endites of the Phyllopod limb are endopodite and exopodite respectively, while the flabellum is the homologue of the epipodite of the "typical" Crustacean limb.

vaginate. The entoderm (at least in several types) arises by delamination; there is a large mid-gut, with well-developed glands ("liver") while the proctodeum is short. The genital glands are reticulate and the spermatozoa are motile.

There is little to be said upon the foregoing points, to which many more, applicable to both Xiphosures and some Arachnids, might be added. The exact serial correspondence of the respiratory metameres in Limulus and the Scorpions have been enlarged upon by Lankester ('81^a), and considerable emphasis must be placed upon the fact that in all Arachnids the stomata are ventral, and are, in all instances, except in possibly the Solpugids and a few mites, are confined to the abdomen. These exceptions need new study. In the Scorpion, as in Limulus, the observations of Narayanan ('89) and Laurie ('90) show that the genital ducts are modified nephridia, and that they open upon the posterior surface of the first abdominal appendages. Delamination has been shown to occur in the Pseudoscorpions, Araneina, Phalangids and Limulus, as well as in the doubtfully Arachnidan Pycnogonids.

SUB-CLASS I—GIGANTOSTRACA SEU MEROSTOMATA.

Six pairs of cephalothoracic limbs around the mouth, the bases of the posterior pairs being masticatory. Behind the mouth a metastomial plate or pair of plates. Anterior edge of carapax acute, its upper surface bearing median ocelli and a pair of lateral compound eyes. Respiration by means of lamellate branchiæ (gill books) borne on appendages 2–6 of the abdomen and protected by the enlarged first pair (operculum) which covers them.

To these points, which cover both Xiphosures and Eurypterids, the following, derived from Limulus, may be added: No salivary glands, no Malpighian tubes, no embryonic membranes (amnion).

In this sub-class two orders are to be recognized, the Eurypterida (fossil) and the Xiphosures. In the latter are included the recent and fossil Limuloid forms. The difference between these is not readily formulated, but is readily recognized in the specimens. The affinities of Cyclus are uncertain.

Order I—Xiphosura.

Cephalothorax large, metastoma paired, telson elongate and spiniform,

Sub Order I—Limulidæ.

Abdominal somites six, coalesced.

Sub-Order II—Hemiaspida.

Abdominal somites more than six, free.

Order II—Eurypterida.

Cephalothorax small, abdomen large and elongate, twelve-jointed, the joints free, telson spatulate, metastoma unpaired.

SUB-CLASS II—ARACHNIDA.

Respiration by internal lungs or tracheæ, no compound eyes Entodermal Malpighian tubes present; Embryonic membrane (amnion) present in some.

I regard the Scorpionida as the most primitive type of Arachnida existing to-day, and the Acarina as the farthest removed from the original stem. This position of the Scorpions is shown by many facts of structure; and the pulmonate type of respiration—intermediate between the gills of the Gigantostraca and the tracheæ of the higher Arachnids—occuring in these forms is just what we should expect if the line of descent is, as here maintained, from branchiate forms. On the other hypothesis of a common origin of all "Tracheates" from some Peripatoid form, we should have the strange spectacle of the most primitive of all Arachnids with the most differentiated respiratory system.

In the Arachnida I recognize the following orders:[3]—I, Scorpionida; II, Thelyphonida; III, Araneida, IV, Solpugida;[4] V, Pseudoscorpii; VI, Phalangida; VIII, Acarina.

It is interesting to note in this connection that Pocock, on morphological grounds points out (Ann. & Mag, Nat. Hist., VI,

---

[3] In this I follow the order of Pocock (Ann. & Mag. N. H., Jan., 1893). His "sub-classes" Ctenophora, Lipoctena and super ordinal divisions Chaulogastra, Mycetophora and Holostomata are hardly to be regarded as of phylogenetic value.

[4] No group of Archnids will better repay study than this. I do not believe that the distinction between the "head" and the "thorax" with its three distinct somites indicates any affinities with the Hexapods, but that the conditions here existing are to be best explained upon the ground of homoplassy. The position of the anterior stigmata in the first thoracic somite is of great interest,

xi, p. 2) that "the immediate ancestor of the Arachnida was constructed somewhat as follows: The body was composed of eighteen somites, the anterior of which were provided with large appendages set apart for locomotion and the prehension and mastication of food; the terga of this cephalothoracic region were fused to form a single shield or carapace, supporting a submedian and a cluster of lateral eyes at each side, and the ventral surface of the carapace [? cephalothorax], at least in its posterior half, was protected by a sternal plate. Each of the succeeding six somites bore a pair of small ventral appendages, and the generative aperture opened upon the sternal area of the first of these somites. The posterior six somites had lost their appendages, were probably narrower than the rest, and constituted a limbless caudal portion of the body, the last of them being furnished with a single plate, articulated above the anal aperature." This should be compared with one of the Eurypterida.

SUB-PHYLUM II—INSECTA SIVE ANTENNATA.

Arthropods with differentiated head consisting of procephalic lobes and four (five[5]) somites; head with somites anchylosed and provided with four pairs of appendages modified for sensation or for feeding; respiration by means of tracheæ (modified glands) opening to the exterior on the sides of the body in the post-cephalic region. Nephridia absent, except as genital ducts, which open near the posterior extremity of the body. Ectodermal Malpighian tubes present. Spermatozoa motile.

So far as I am aware, the dissolution of the old group Myriapoda and the union of the Chilopoda with the Hexapoda was first proposed by Pocock ('87). At about the same time, I taught the same view to my classes, and later ('88) published the same. Subsequently both Pocock ('93) and I ('93, p. 248 ff.) repeated our views within a month of each other.[6] This step, it seems to me, is fully justified. The affinities of the Chilopods to the Hexapods are most close, while those of Chilopoda and

---

[5] See p. 125.

[6] One of our best students of the Myriapoda, the late C. H. Bollman, accepted my views and they appear in the posthumous collection of his papers ('93).

Chilognatha are quite obscure. There has been no greater stumbling-block for morphologists than the attempt to homologise the somites of millipeds and centipedes. Attempts to bring other organs into harmony are equally futile. The three groups under discussion may be contrasted as follows, it being of course admitted that we know next to nothing of the somites and serial homologies of either Diplopod or Chilopod, and that possibly future research will modify some of the statements below.

The Diplopod head bears, besides the antennæ, but two pairs of appendages—a pair of mandibles and a lower lip, composed of a pair of coalesced maxillæ.[7] In the Chilopod the conditions are as in the Hexapod, two pairs of maxillæ being present.

In the Chilopods, as in the Hexapods, each somite bears a single pair of appendages, while in the Diplopods the majority of the segments bear two pairs of appendages, and the researches of Heathcote ('88) show that each segment is, in reality, composed of two coalesced somites, a condition without parallel elsewhere in the Arthropoda. In the Chilopods there is a wide sternum separating the coxæ of the ambulatory appendages; in the Diplopods the coxæ are approximate, and the sternum is exceeding narrow, or even entirely absent.

In the Chilopods the stigmata, a pair to a somite, are lateral (dorsal in Scutigera), and are placed above and outside the insertion of the limbs, exactly as in the Hexapods. The tracheæ which arise from them are branched, and the intima is thrown into a well-developed spiral thickening as in the six-footed insects. In the Diplopoda, on the other hand, the stigmata are beneath the body[8] close to the legs, while the tracheæ (ex-

[7] The attempt made to show that this lower lip is composed of the two coalesced lower jaws, or first and second maxillæ, of the Chilognaths receives no support from the embryology of Julus (Heathcote '88), where there is but a single somite when the hypothesis calls for two. Further the innervation of the sense organs of the lower lip (*cf.* vom Rath, '86, Pl. XX, Fig. 1) shows that but a single pair of appendages is concerned in the part.

[8] In former papers I have said that the spiracles might be even *in* the coxæ. I recall having seen this statement but recently rather rather extensive reading of Myriapod literature fails to reveal my authority.

cept in the Glomeridæ) are tufted and unbranched, and the thickening of the intima is poorly developed.

In the Diplopods there are well-developed foramina repugnatoria upon the sides of each somite of the body. Such structures are absent from the Chilopods (as from the Hexapods), except in a few Geophilidæ, where repugnatorial glands occur, opening by foramina in the mid-ventral line.

In the Chilopods the reproductive organs consist of paired[9] gonads situated above the alimentary canal and opening to the exterior by ducts which are at first paired, but which later unite into a common tube which leads to a single external opening situated in the penultimate segment of the body. In the Hexapods the conditions are almost exactly the same; the gonads are dorsal, the genital ducts unite (except in Ephemeridæ), and there is a single external opening, always at the posterior end of the abdomen. In both Hexapods and Chilopods the spermatozoa are motile. In the Diplopods there is a single unpaired gonad, situated beneath the alimentary canal, and the genital duct, passing forward, divides into two, each of which has its own opening at the bases of the legs of the second post cephalic segment. The spermatozoa are quiescent.

We know so little of the embryology of the Myriapods that the aid of development can be had to only a slight extent in our comparisons,but the facts which it affords seem important. In the Chilopods the embryo escapes from the egg with numerous ambulatory appendages, a pair to each somite. The same is true of the typical Hexapods, all later observers agreeing that a polypod precedes a hexapod condition. The young Diplopod escapes from the egg in a Hexapod condition, and the presence of these six legs has been seized upon as a proof of the near association of these forms. An exact comparison, however, seems to show that the two are in reality very unlike as appears in the following table.[10]

---

[9] Single in Scolopendra.

[10] As nothing is known of the existence of a tritocerebral segment in the Diplopods, the comparison can only be made upon the basis of the appendages of the adult. If the tritocerebral segment should prove lacking in the millepeds, the contrast will prove stronger than it now is. The statement of the Diplopod appendages is based upon Heathcote ('88).

	HEXAPODA (+CHILOPOD).		DIPLOPOD.	
Appendage I	Antenna	Head	Antenna	Head
" II	Mandible		Mandible	
" III	Maxilla 1		Lower Lip	
" IV	Maxilla 2		Foot 1	
" V	Thoracic Foot 1	Thorax	Absent	
" VI	Thoracic Foot 2		Foot 2	
" VII	Thoracic Foot 3		Foot 3	
" VIII	Abdominal Foot 1		Absent	
" IX	Abdominal Foot 2		Absent	

CLASS I—CHILOPODA.

Insecta with elongate depressed body, no differentiation between thorax and abdomen, all the somites being provided with appendages, those of the thorax-abdomen being locomotor in function.

CLASS II—HEXAPODA.

Insecta with body consisting of not over 19 somites, divided into head, three-jointed thorax and abdomen. Thorax provided with three pairs of locomotor appendages, and usually with two pairs of wings; abdominal appendages usually lacking from most somites, those of the extremity being usually modified for reproduction and sensory purposes, those of the other somites, when present, being weak.

SUB-PHYLUM III—DIPLOPODA SIVE CHILOGNATHA.

Elongate, homonomously segmented Arthropods; head distinct, bearing three pairs of appendages; no distinction between thorax and abdomen; this region with numerous somites, all, except the anterior, having two pairs of appendages (double somites), sternum narrow. Stigmata two to each somite, tracheæ tufted and unbranched, not anastomosing. Gonads single, beneath the alimentary canal; spermatoza quiescent; genital ducts opening between the bases of the second and third pairs of feet.

I have given above my reasons for the separation of the Diplopods from the Chilopods, and need not repeat them here. I do not discuss the relations of the Diplopoda to the other sub-phyla, nor the relative position to be accorded the group. The ventral position of the gonads is a mark of low rank, but in other respects the organization is much higher.

ARTHROPODA OF UNCERTAIN POSITION.

I—Pycnogonida sive Pantopoda.

Regarding the systematic position of these forms I cannot add anything to the remarks of Morgan ('90), who has shown that not only in adult structure but in certain features of development, notably in the formation of the entoderm by delamination, they present conditions not easily paralled outside of the Arachnida, and it is not impossible that they may belong there. The appendages are easily homologised in the two groups, and especially interesting is the fact that while most genera in the female retain a primitive condition in having the genital ducts open upon several pairs of appendages (IV–VII), in a few these openings occur only on the seventh appendage, exactly where they occur in the Scorpions.

II—Linguatulina.[11]

These forms, frequently associated with the Arachnids, possess but few points of similarity with them. Chief among these are the concentration of the nervous centres to a circumœsophageal ring, and the peculiar arrangement of the ovarian follicles. On the other hand, neither embryos nor adult resemble any Arachnids in more than a few superficial features. The opening of the genital ducts in the female near the posterior end of the body is not Arachnid in character, nor is the absence of "liver" lobes from the mid-gut. Besides, as non-Arthropodan characters, may be mentioned the extensive cœlom and the outer circular body muscles. The species of Pentastomæ have been so modified by parasitism that it is

---

[11] Upon points of structure and development consult Stiles ('91) and Spencer ('92), in addition to the older literature.

difficult to say whether the lack of other structures characteristic of Arthropods is due to primitive simplicity or to degeneration.

III—PAUROPODA.

The position of the Pauropoda is, as yet, very uncertain, as we are almost entirely ignorant of their internal structure. In the tendency towards a fusion of somites, in the lack of a second pair of maxillæ, and in the positions of the external paired openings of the genital ducts at the base of the second pair of ambulatory appendages and the non-motile spermatozoa they show undoubted affinities with the Diplopoda; but the peculiar triramous antennæ and especially the characters of the hexapod young, as figured by Lubbock ('67) and Ryder ('79) show important differences. The following table compares the somites of Pauropus and the Diplopod:

	DIPLOPOD.	PAUROPOD.
Appendage I	Antenna	Antenna
" II	Mandible	Mandible
" III	Lower Lip	Lower Lip
" IV	Foot 1	Absent
" V	Absent	Foot 1
" VI	Foot 2	Foot 2
" VII	Foot 3	Foot 3

IV—TARDIGRADA.

Elongate metameric animals with four pairs of appendages, each terminating with two double hooks. Mouth and anus terminal, Malpighian tubes present, opening into the hind-gut. Nervous system consisting of a supraœsophageal brain and a chain of four ventral ganglia. No specialised circulatory or respiratory organs. No coxal glands or nephridia. Sexes separate, gonad unpaired, emptying into hind-gut.

Most frequently the Tardigrades are associated with the Arachnida, but this has doubtless been due to the possession of four pairs of functional legs in the two groups. These forms

differ from the Arachnids in the absence of all mouth parts,[12] in the proctodeal excretory tubes, the simple nervous system, smooth muscular tissue, and in the absence of nephridia, and they further differ from not only the Arachnids, but from all Arthropods in the fact that the gonads open into the hind-gut.

V—MALACOPODA.[13]

The Arthropodan features of the Malacopoda, represented by the single genus Peripatus, are the tracheæ, the legs terminating in claws, the appendicular nature of the jaws, the exclusive use of a pair of nephridia for genital ducts, the reduced cœlom; the several ostia of the heart, the heart being enclosed in a pericardium; the lacunar circulation. On the other hand, the Malacopoda differ from all other Arthropoda and agree with the Annelids in the following particulars:

The presence of functional nephridia in each body segment; the presence of well-developed coxal glands; the existence of an outer circular muscular layer in the body wall; the absence of striation from all muscles except those of the mouth parts; the presence of cilia in the alimentary canal and in the nephridia; the situation of the antennæ as outgrowths from the primitively preoral region; the muscular nature of the pharynx, unlike that of any Arthropod and strikingly that of certain Chætopods. The eyes are too unlike the usual organs of any other Arthropod, but, as figured by Balfour, they closely resemble these organs in Autolytus. There is, too, an absence of a well-developed external cuticular skeleton, so that the absence of a true jointing in the appendages is noticeable. Judging from figures, the terminal claws of the legs might be compared with the setæ of the annelid parapodium.

On the whole, Peripatus cannot be placed beyond question in the Arthropodan phylum, and it is doubtful if it would have been placed there were it not for the presence of tracheæ.

---

[12] The internal acicular teeth can hardly be regarded as appendages.

[13] I prefer to use the term Malacopoda for this group, because it is the oldest, being given by Blanchard in 1847. Onychophora of Grube dates from 1853, Protracheata was given by Mosely in 1874. The failure of Blanchard to recognize all points of structure does not invalidate his name.

As we have already pointed out the existence of three different kinds of tracheæ which cannot be traced to a common origin, it is barely possible that those of Peripatus and the other "Tracheates" are not strictly homologous.

LITERATURE CITED.

'52 **Barrande, J.** Système Silurien du Centre de la Bohéme. Prag., 1852.

'71 **van Beneden, Edouard.** [No title.] *Comptes Rendus Soc. Ent. Belg.*, p. ix. 1871.

'92 **Bernard, H. M.** The Apodidæ. London, 1892.

'93 **Bernard, H. M.** The coxal glands of Scorpio. *Ann. & Mag. Nat. Hist.*, VI, xii, p. 54. 1893.

'90 **Boas, J. E. V.** Lehrbuch der Zoologie. Jena. 1890.

'93 **Bollman, C. H.** The Myriapoda of North America. *Bull U. S. Nat. Mus. No.* 46, 1893.

'82 **Brooks, W. K.** Lucifer, a study in morphology. *Phil. Trans.* 1882.

'87 **Bruce, A. T.** Observations on the embryology of Insects and Arachnids. Baltimore, 1887.

'91 **Bumpus, H. C.** The embryology of the American lobster. *Jour. of Morph.*, v. 1891.

'90 **Carriere, J.** Die Entwicklung der Mauerbiene (Chalicodoma muraria). *Arch. f. mikr. Anat.*, xxxv. 1890.

'75 **Chun, C.** Bau, Entwicklung und physiologische Bedeutung der Rectaldrüsen bei den Insekten. *Abh. Senkenb. Gesell. Frankfurt*, x. 1875.

'91 **Cholodkowsky, N.** Die Embryonalentwicklung von Phyllodromia (Blatta) germanica. *Mem. Acad. St. Petersburg*, VII, xxxiii. 1891.

'73 **Claus, C.** Zur Kenntniss des Baues und die Entwicklung von Branchipus stagnalis und Apus cancriformis. *Abhandl. k. Gesellsch. der Wissenschaft zu Göttingen, Bd. xviii*, 1873.

'86ª **Claus, C.** Prof. E. Ray Lankester's Artikel "Limulus an Arachnid" und die auf denselben gegründeten Prätensionen und Anschuldigungen. Also "Schlusswort" u. a. *Arb. zool. Inst. Wien*, vii. 1886–7.

'86^{b} **Claus, C.** Reply to Prof. E. Ray Lankester's "rejoinder." *Ann. & Mag. Nat. Hist.*, V, xviii, p. 467. 1886.

'87^{a} **Claus, C.** On the relations of the groups of Arthropoda. *Ann. & Mag. N. H.*, V, xix, p. 396. 1887.

'87^{b} **Claus, C.** Lehrbuch der Zoologie. Vierte Aufl. Marburg, 1887.

'90 **Fernald, H.** The relationship of Arthropods. *Studies Biol Lab. Hopkins Univ.* iv. 1890.

'79 **Grobben, C.** Die Entwicklungsgeschichte der Moina. *Arb. zool. Inst., Wien*, ii. 1879.

'92 **Grobben, C.** A contribution to the knowledge of the geneaology and classification of the Crustacea. *Annals & Mag. Nat. Hist.*, VI, xi, p. 410, 1893, from Sitzungsbr. k. Acad. Wissench. Wien.; Math-Nat. Classe, Bd. ci, Heft. ii, Jahrg., 1892; Abth. x, p. 237, 1892.

'85 **Gulland, G. L.** Evidence in favor of the view that the coxal gland of Limulus and other Arachnids is a modified nephridium. *Quar. Jour. Micr. Sci.*, xxv. 1885.

'88 **Hatschek, B.** Lehrbuch der Zoologie, Jena, 1888.

'88 **Heathcote, F. G.** The postembryonic development of Julus terrestris. *Phil. Trans.*, 179. 1888.

'92 **Hertwig, R.** Lehrbuch der Zoologie, Jena, 1892.

'92 **Herrick, F. H.** Alpheus: a study in the development of Crustacea. *Memoirs Nat. Acad. Sci.*, v. 1892.

'90 **Heymons R.** Ueber die hermaphroditische Anlage der Sexualdrüsen beim Männchen von Phyllodromia (Blatta). Zool. Anz. xiii, 1890.

'93 **von Kennell, J.** Lehrbuch der Zoologie. Stuttgart, 1893.

'83 **Kingsley, J. S.** Is the group Arthropoda a valid one? *Am. Nat.*, xviii, p. 1034. 1883.

'85 **Kingsley, J. S.** Notes on the embryology of Limulus. *Quar. Jour. Micros. Sci.*, xxv. 1885.

'88 **Kingsley, J. S.** The classification of the Myriapods. *Am. Naturalist*, xxii. 1888.

'89 **Kingsley, J. S.** The development of Crangon vulgaris, III. *Bull. Essex. Inst.*, xxi. 1889.

'90 **Kingsley, J. S.** The ontogeny of Limulus. *Am. Naturalist*, xxiv, and *Zool. Anz.*, xiii. 1890.

'92 **Kingsley, J. S.** 'The embryology of Limulus. *Jour. Morphol.*., vii. 1892.

'93 **Kingsley, J. S.** The embryology of Limulus. Part II. *Journal of Morphology.* Vol. viii. 1893.

'90 **Kishinouye, K.** On the development of the Araneina. *Jour. Coll. Science, Univ. of Japan*, iv. 1890.

'91 **Kishinouye, K.** On the development of Limulus longispina. *Jour. Coll. Sci., Univ. of Japan*, v. 1891.

'92 **Korschelt, E. and Heider, K.** Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere Zweites Heft. Jena. 1892.

'89 **Lang, A.** Lehrbuch der vergleichenden Anatomie. Zweite Abth. Jena. 1889.

'81 **Lankester, E. R.** Limulus an Arachnid. *Q. J. M. S.*, xxi. 1881.

'81 **Lankester, E. R.** Observations and reflections on the appendages and on the nervous system of Apus cancriformis. *Q. J. M. S.*, xxi. 1881.

'84 **Lankester, E. R.** On the skeleto-trophic tissues and coxal glands of Limulus, Scorpio and Mygale. *Q. J. M. S.*, xxiv. 1884.

'90 **Laurie, M.** The embryology of a scorpion. *Q. J. M. S.*, xxxi, 1890.

'92 **Laurie, M.** On the development of the lung-books of Scorpio fulvipes. *Zool. Anz.*., xv. 1892.

'92 **Lebedinsky, J.** Die Entwicklung der Coxaldrüsen bei Phalangium. *Zool. Anz.*, xv. 1892.

'86 **Locy, W. A.** Observations on the development of Agelena nævia. *Bull. Mus. Comp. Zool.*, xii. 1886.

'78 **Leydig, F.** Ueber Amphipoden und Isopodon. Anatomische und zoologische Bemerkungen. *Zeit. wiss. Zool.* xxx, suppl. p. 225. 1878.

'86–'87 **Loman, J. C. C.** Ueber die morphologische Bedeutung der sog. malpighi'schen Gefässe der echten Spinnen. *Tijdsch. nederl. Dierk. Vereen*, II, i. 1886–1887.

'67 **Lubbock, J.** On Pauropus, a new type of centipede. *Trans. Linn. Socy.*, xxvi, p. 181. 1867.

'84 **MacLeod, J.** Recherches sur la structure et la signification de l'appareil respiratoire des Arachnides. *Arch. Biol.*, v. 1884.

'93 **Matthews, W. D.** On antennæ and other appendages of Triarthrus beckii. *Am. Jour. Sci.*, III, xlvi. 1893.

'83 **Mickleborough, J.** Locomotive appendages of Trilobites. *Am. Nat.*, xvii, 1383. From *Jour. Cincinnati N. H. Socy.*

'40 **Milne-Edwards, H.** Histoire Naturelle des Crustacés. Tome. iii. Paris, 1840.

'91 **Morgan, T. H.** A Contribution to the embryology and phylogeny of the Pycnogonids. *Studies Biol. Lab. Johns Hopkins Univ.*, v. 1891.

'89 **Narayanan, M.** Notes on the anatomy of scorpions. *Q. J. M. S.*, xxx. 1889.

'87 **Packard, A. S.** On the Syncarida, a hitherto undescribed group of Malacostracous Crustacea. *Memoirs National Acad. Science*, iii.

'86 **Packard, A. S.** On the class Podostomata, a group embracing the Merostomata and Trilobites. *Am. Naturalist*, xx, p. 1060. 1866.

'84 **Patten, W.** The development of Phryganids. *Q. J. M. S.* xxiv. 1884.

'88 **Patten, W.** Studies on the eyes of Arthropods. II. The eyes of Acilius. *Jour. Morph.*, ii. 1888.

'90 **Patten, W.** On the origin of Vertebrates from Arachnids. *Q. J. M. S.*, xxxi. 1890.

'87 **Pocock, R. I.** On the classification of the Diplopoda. *Ann. and Mag. N. H.* 1887.

'93 **Pocock, R. I.** On the classification of the Tracheate Arthropoda. *Zool. Anz.*, xvi. 1893.

'86 **vom Rath, O.** Beiträge zur Kenntniss der Chilognathen. *Inaug. Diss.* Bonn. 1886.

'86ª **vom Rath, O.** Die Sinnesorgane der Antennæ und der Unterlippe der Chilognathen. *Arch. f. mikr. Anat.*, xxvii. 1886.

'79 **Ryder, J. A.** An account of a new genus of minute Pauropod Myriapods. *Am. Nat.*, xiii, p. 603. 1879.

'87 **Schimkewitsch, W.** Etude sur le développement des Araignées, *Arch. de Biol.*, vi. 1887.

'88 **Sedgwick, A.** A monograph of the development of Peripatus capensis. *Studies Morph. Lab. Cambridge*, iv. 1888. From *Q. J. M. S.*, 1885–88.

'46 **Siebold, C. Th. von.** Lehrbuch der vergleichenden Anatomie, Wirbelloser Thiere. Berlin, 1846.

'92 **Sinclair, F. G.** A new mode of respiration in Myriapods. *Phil. Trans.* 183 B. 1892.

'85 **Spencer, W. B.** The urinary organs of Amphipoda. *Q. J. M. S.*, xxv. 1885.

'91 **Sturanay, R.** Die Coxaldrüsen der Arachnoiden. *Arb. Zool. Inst. Wien.*, ix. 1891.

'92 **Spencer, W. B.** The anatomy of Pentastomum teretiusculum (Baird) *Q. J. M. S.*, xxxiv. 1892.

'91 **Stiles, C. W.** Bau und Entwicklungsgeschichte von Pentastomum proboscideum Rud. und Pentastomum subcylindricum Dies. *Z. w. Z.*, lii. 1891.

'91 **Viallanes, H.** Sur quelques points de l'histoire du développement embryonnaire de la Mantis religieuse (Mantis religiosa. *Ann. des Sci. Nat.*, xi. 1891.

'81 **Walcott, C. D.** The Trilobite: new and old evidence as to its organization. *Bull. Mus. Comp. Zool.*, vii. 1881.

'84 **Walcott, C. D.** Appendages of the Trilobite. *Science*, iii. 1884.

'89 **Weldon, W. F. R.** The cœlom and nephridia of Palæmon serratus. *Jour. Marine Biol. Assoc.*, *N. S.*, i. 1889.

'91 **Weldon, W. F. R.** The renal organs of certain Decapod Crustacea. *Q. J. M. S.*, xxxii. 1891.

'92 **Weldon, W. F. R.** The formation of the germ layers in Crangon vulgaris. *Q. J. M. S.*, xxxiii. 1892.

'89 **Wheeler, W. M.** The embryology of Blatta germanica and Doryphora decemlineata. *Jour. Morph.*, iii. 1889.

'93 **Wheeler, W. M.** A contribution to Insect Embryology. *Jour. Morph.*, viii. 1893.

'79 **Wood-Mason, J.** Morphological notes bearing on the origin of Insects. *Trans. Ent. Socy. London.* 1879.

ON A SMALL COLLECTION OF VERTEBRATE FOSSILS FROM THE LOUP FORK BEDS OF NORTHWESTERN NEBRASKA; WITH NOTE ON THE GEOLOGY OF THE REGION.

BY J. B. HATCHER.[1]

The Princeton Scientific Expedition of 1893, besides securing a quite complete series of fossils from the Protoceras beds of the upper White River, was also fortunate in securing small, but interesting collections from the Loup Fork and overlying Equus beds, and in discovering unconformities between the latter. These unconformities made it possible to distinguish sharply between the top of the Loup Fork and the base of the Equus beds; and consequently to separate the fossils of the one from those of the other with certainty.

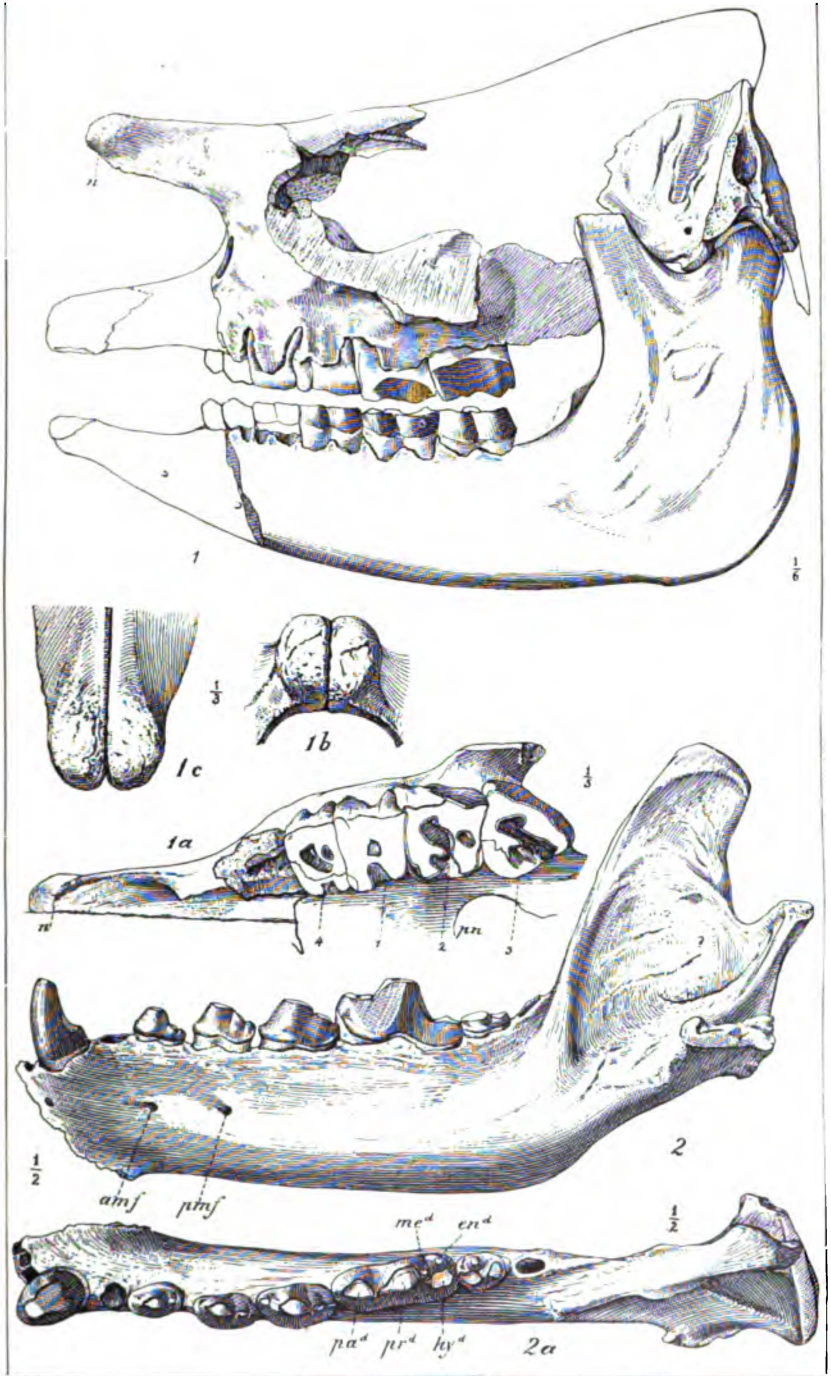
The work in the Loup Fork and Equus beds was done by the writer previous to the arrival of the other members of the expedition. The material collected was found in the adjacent hills on the south side of the Niobrara river, midway between the mouths of Pine and Box Butte creeks in Sheridan Co., Nebraska. The material from the Loup Fork beds has been placed in my hands for description through the kindness of Prof. W. B. Scott, under whose direction the expedition was undertaken. It contains, besides several species already fully described from these beds, the following material representing one new genus, and three new species and presenting interesting characters not before noticed in species already known.

AELURODON TAXOIDES, sp. n.

Among the Loup Fork Carnivora, the genus Aelurodon was predominant, both as to individuals and species represented. In size they were propably only equalled among the Carnivora of this epoch by the sabre-toothed cats. In the latter they doubtless found formidable enemies.

---

[1] Curator of Vertebrate Paleontology of Princeton College.



R. WEBER, DEL.

The type of this species consists of a very complete and well preserved left mandibular ramus. It belonged to an animal about the size of the black bear. The mandible is long and proportionately slender. Posterior depth but little greater than anterior. Masseteric fossa very deep, its anterior border ending directly below the third molar. Anterior mental foramen directly below middle of second premolar. Posterior mental foramen directly below posterior root of third premolar. Surface between anterior margin of masseteric fossa and a point below the middle of the sectorial quite concave. Inferior border nearly straight from synphysis to a point directly beneath the posterior border of the second molar, when it rises quite rapidly to the angle, much as in the badger (*Meles taxus*) thus suggesting the specific name. The angle is considerably expanded transversely for the attachment of the masseter muscle. The exterior border of this expansion is on a line with the base of the teeth. The condyle is strong. The coronoid process is quite high and proportionately somewhat slender. Its upper and anterior borders, especially the latter, are considerably expanded transversely to give greater surface for the attachment of the temporal muscle. The inner border of the ramus is a nearly plane surface, except anteriorly where it is strongly convex. The dental foramen is situated about midway between molar three and the angle, and is on a line with the alveolar border. The symphysis is small and triangular in outline, and is extended somewhat below the inferior border of the jaw. Its supero-inferior diameter is about twice that of the antero-posterior diameter.

The Teeth: The incisors are missing, but they are represented by three somewhat shallow alveoli crowded closely together. The internal and middle incisors were about equal in size and quite small. The latter was crowded considerably backward out of line with the external and internal. The external incisor was considerably larger than incisors one and two. The canine is only moderately strong and is oval in cross-section at the base. The first premolar is missing, but the alveole is well preserved and shows it to have been of moderate size and fixed by one root only. There is a diastema between it and

the canine and a shorter one between it and premolar two. Premolars two, three, and four are strong, well developed teeth, they increase regularly in size and are separated by diastemata. The sectorial is large as compared with molars two and three, its antero-posterior diameter being almost double that of both these teeth taken together. The metaconid is exceedingly faint, the talon is low and flat and consists of both an external and internal cone of which the former alone has been subjected to wear. Molar two is quite small, not so large as premolar two. Molar three is missing but the alveole shows it to have been quite rudimentary and implanted by one root only in the slightly rising alveolar border of the jaw.

The present species appears to be most closely related to *A. uirsinus* Cope and *A. haydenii* Leidy. From the former it is readily distinguished by the nearly uniform depth of the jaw, by the much smaller canine and by the relative and absolute size of the premolar and tubercular teeth. In *A. ursinus* according to Cope[2] the first tubercular considerably exceeds in size the fourth premolar, in *A. taxoides* the fourth premolar is twice the size of the first tubercular. From *A. haydenii* it is at once distinguished by the much less elevated posterior portion of the alveolus, by the somewhat less massive appearance of the jaw and by the diastemata between the premolars. The following are the more important measurements of the type specimen.

	M.
Length of jaw from front of synphysis to middle of condyle	.207
Length of premolar dentition	.062
Length of molar dentition	.053
Antero-posterior diameter of sectorial	.034
Antero-posterior diameter of first tubercular	.012
Antero-posterior diameter of fourth premolar	.022
Depth of ramus below first premolar	.039
Depth of ramus below first tubercular	.040

In Plate I, figures 2 and 2^a represent the side and crown views of the type and show well the more important charac-

---

[2] See U. S. Geogr. S , G. M. Wheeler, part II, Vol. IV, p. 304, 1877.

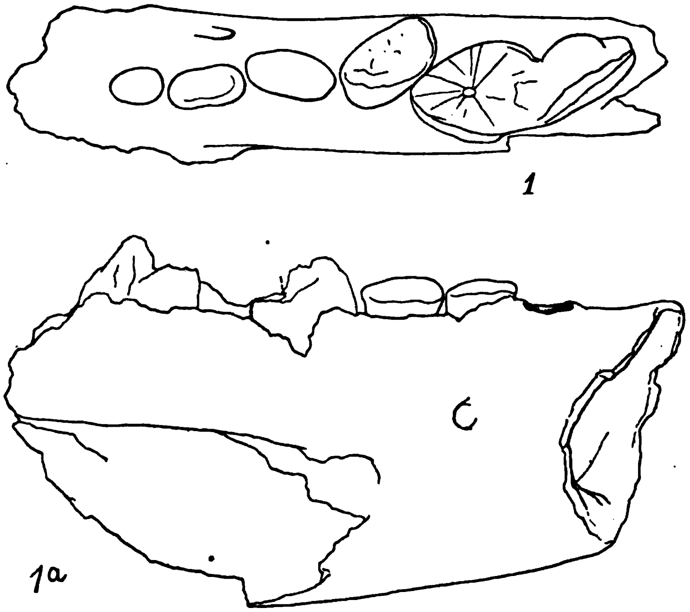
ters. An atlas vertebra found in connection with the type specimen shows a distinct foramen for the inferior branch of the first spinal nerve, but presents no other distinctive characters.

AELURODON MEANDRINUS, sp. n.

This species is by far the largest of the genus yet described. The type consists of the right mandibular ramus, broken off at the canine and just back of the sectorial. It indicates an animal about the size of the grizzly bear. The jaw was exceedingly strong and massive in proportion to its length. The crowns of premolars two and three are preserved and the roots of the sectorial and premolar four. The symphysis is quadrangular in shape and extends backward to below the middle of premolar three, its upper border approaches very closely the alveolar border. The anterior mental foramen is large and is situated just below the posterior root of premolar two. The arrangement of the teeth is especially characteristic and has suggested the specific name. The second, third, and fourth premolars are implanted in the the jaw in a zig-zag manner. The anterior end of premolar three is entirely outside of the posterior root of premolar two. Premolar four is set quite as much transversely as longitudinally in the jaw, its posterior root being as much outside of as behind the anterior. The anterior root of the sectorial is inside of and overlaps the posterior root of premolar four. This arrangement of the teeth is well shown in figs. 1 and 1^a.

The canine was very large as indicated by the alveole which is partially preserved. There was a long diastema between it and premolar one. The latter tooth was small and fixed by one root only. Premolars two and three are small and nearly equal in size. Premolar four is much larger than two and three. All the premolars are separated by very small diastemata. The sectorial is exceedingly large, its antero-posterior diameter equalling in length the space occupied by premolars two, three, and four. In fig. 1 only about half the posterior root of the sectorial is shown, thus making the tooth appear shorter than it really is. The following are the principal measurements of the type.

	M.
Length of premolar dentition	.060
Antero-posterior diameter of sectorial	.047
Length of diastema between canine and P. 1.	.019
Depth of ramus below P. 1.	.050
Depth of ramus just behind P. 4.	.055



APHELOPS, Cope.

Cope has defined the genus Aphelops as follows.[3] Dentition: I ? $\frac{2-1}{1}$, C $\frac{1}{1}$, P $\frac{4-3}{3}$, M $\frac{3}{3}$; post-glenoid and post-tympanic process in contact but not coossified; digits 3–3; nasals hornless. To these characters Osborn[4] has added: "Magnum not supporting lunar anteriorly; absence of the crista and invariable presence of the more or less strongly developed 'crochet' and 'anticrochet' in the superior molars." The projection referred to by Prof. Osborn as the anticrochet is, I think, really the crista, since it is produced quite as much or more from the

---

[3] Bull. V, U. S. G. S.. 1879–80.

[4] Bull. Mus. Comp. Zool. Harvard, p. 92.

upper border as from the lateral, and moreover, an examination of material in our collection shows in molar one of Aphelops and molor two of Teleoceras an additional small projection directly opposite the large anticrochet, and which I believe to be the crochet and have so lettered it. See Plate II, figs. 5 & 6. I would therefore amend Prof. Osborn's dental characters to read as follows: Invariable presence of strong anticrochet and crista and absence of well defined crochet on superior molars. If this projection is not the crista, it is the crochet instead of the anticrochet, as considered by Osborn.

APHELOPS FOSSIGER, Cope.

I have referred a nearly complete skull in our collection to the above species. It differs from Cope's definition of that species however by the following characters which may perhaps be considered of specific importance. In molar one the the median sinus is obstructed by a large crista and anticrochet and a very small crochet, in molar two there is no trace of a crochet and at the bottom of the entrance of the median sinus there is a small tubercle. In molar three at the bottom of the entrance of the median sinus, there is an elongated tubercle placed transversely, and just inside this is a second much smaller conical tubercle. At about the middle and on the upper border of the zygomata there are processes curving inward and downward which probably served as attachments for the zygomatico-auricularis muscles. The molar teeth also are extremely large. Below are some of the measurements.

	M.
Length of true molars	.168
Median length of second molar	.062
Greatest length of second molar	.075
Greatest width of second molar	.077

TELEOCERAS MAJOR, Hatcher.

As stated in a preliminary notice,[5] this genus is distinguished from all previously known genera of the *Rhinoceridæ* by

[5] Am. Geol., March, 1894, pp. 149–150.

the presence of a median horn on the extremities of the nasals, the presence of a sagittal crest? as indicated by the contour of the outer walls below this region and the presence of a strong anticrochet and crista and the absence of a well developed crochet on the superior true molars.

The type consists of a portion of the skull and lower jaw. The superior and inferior molars are preserved and also the fourth upper premolar. The skull is long and proportionately much deeper and narrower than in the closely allied genus Aphelops. The nasals are only partially coossified, they are very thick and strong, much compressed anteriorly and strongly convex superiorly. Their extremities are prolonged into a short, stout horn which extends about an inch beyond the extremities of the nasals proper, and is directed upward and forward, it is slightly constricted inferiorly just in front of the termination of the nasals; it is rugose and in life evidently supported a dermal horn. These characters are well shown in Plate I, figs. 1, 1^b, 1^c, 1^d. The frontals are comparatively narrow and smooth, and their upper transverse surface is gently convex, they are elevated posteriorly so that the median line from the posterior portion of the frontals to the end of the nasal horn is slightly concave. The infra-orbital foramen is large, opens anteriorly and not laterally directly over the middle of premolar three. The maxillaries are large, strong and deep. The anterior border of the posterior nares is on a line with the posterior border of the median sinus of molar two, there is no median projection. The temporal region is much constricted, the inferior lateral walls of the brain case in this region are exceedingly thin, there were no air cavities in this region of the skull. The base of the skull sloped upward and forward from the condyles which are missing. The post-glenoid process is strong and triangular in cross-section, it is confluent *but not coossified* with the post-tympanic throughout the greater portion of their length, thus entirely enclosing the *meatus auditorius externus.*

The lower jaw is exceedingly strong and massive. The ascending portion is very high and broad with the posterior border but slightly expanded transversely. The masseteric

fossa is very shallow. The inferior dental foramen is large. The coronoid process is wide at the base and narrows rapidly toward the apex. The angle is produced but slightly downward. The inferior border is gently convex.

The Teeth: Of the superior dentition the true molars and the fourth upper premolar alone are represented. They are larger than in the recent rhinoceros but much smaller than in *Aphelops* as shown in Plate II, figs. 5, 6, & 9. Molars two and three are best preserved and present the most distinctive characters. The dorsum is very flat, there is no median costa and the anterior and posterior costae are only faintly represented On the posterior angle of molar three there is a well developed basal cingulum. The median sinus of this tooth is obstructed by a well developed anticrochet and crista. At the bottom and near the entrance of the median sinus is a small tubercle. Molar two has a faint crochet directly opposite the strong anticrochet and a well developed crista as shown in Plate II, fig. 6. There was a deep posterior sinus with a strong posterior vallum which in the type has been worn down so that the posterior sinus now appears as a posterior fossette. There is a very small anterior sinus and the anterior vallum is weak. In molar one and premolar four the teeth are so much worn that the anterior and posterior cross-crests are united through the anticrochet, and the inner portion of the median sinus appears as an accessory fossette.

In the inferior dentition the last molar is placed well in front of the ascending portion of the ramus, it is but little larger than molars one and two, and has a basal cingulum on the posterior border. The following are the principal measurements of the skull, lower jaw, and teeth.

SKULL AND SUPERIOR DENTITION.

	M.
Length of skull from end of nasal horn to behind post-tympanic process	.585
Depth of skull from middle of frontals to crown of teeth	.235
Width of skull in front of zygoma	.210

Length of horn beyond termination of nasals	.028
Diameter of horn	.041
Length of molar dentition	.158
Greatest transverse diameter of molar two	.069
Greatest antero-posterior diameter of molar two	.055

LOWER JAW AND TEETH.

	M.
Length of ramus from anterior border of premolar four to posterior border	.420
Height from bottom of angle to condyle	.260
Depth below molar three	.109
Length of molar dentition	.155
Length of molar two	.054
Length of molar three	.058

Teleoceras although presenting several characters apparently intermediate between Aphelops and existing genera of Rhinoceridæ, nevertheless cannot be considered as an ancestor of the latter. Neither is it a migrant from Europe. It is really a horned Aphelops derived perhaps through Leidy's species *A. crassus;* which latter is not unlikely to be identical with *A. fossiger* (Cope) and *A. acutum* (Marsh), all of which have been described as possessing compressed, acuminate nasals, thus suggesting a horn at the very place where it appears in *Teleoceras.*

The discovery of a *median horned Rhinoceras* in America is of interest not as a probable ancestor of existing Old World forms, but rather as exhibiting a remarkable example of *parallelism* in the development of the Old and New World species of Rhinoceridæ from their common ancestral genus Aceratherium of the lower Miocene of this continent. Our present knowledge would indicate, as has been pointed out by Scott,[6] that the ancestral type originated in America and found its way into the Old World in early Miocene times. The genus Aceratherium which flourished during the lower Miocene was common to both continents, and all the median horned

[6] See Bull. 3, E. M. Museum, Princ. Coll., pp. 1–22, 1883.

and hornless forms of each continent may reasonably be considered to have been developed independently from it. There seems at present no evidence for supposing that there was any interchange of species between the two continents later than early Miocene times. This degree of parallelism is all the more striking when we consider the length of the period of isolation in connection with the marked degree of similarity shown. This similarity is exhibited not only in the development of a nasal horn, but also in the general appearance of the skull, the complexity of the structure of the teeth and their arrangement in the jaw, and the relations of the post-tympanic and post-glenoid processes, Figs. I–4, Plate II, show the latter in the genera Rhinoceros, Teleoceras, Aphelops and Ceratorhinus. On the same plate, figs. 5, 6, 7, 8 & 9 represent various stages of tooth development from Aceratherium to Teleoceras and recent forms. As regards specialization of parts and complexity of tooth structure, from what is at present known of Teleoceras, it may be regarded as equalling in these respects any of our recent forms. If we compare it with *Rhinoceros sansaniensis* (Lartet) from a horizon in France of which our Loup Fork has been considered an equivalent, it will at once be seen that the tooth structure of the latter is much simpler and more like Aceratherium. See Plate II, fig. 7 (after Filhol). If these beds be really of the same age we must conclude that the conditions favorable for the development of the more modern types of the Rhinoceridæ, existed to a much greater degree in America than in Europe, a condition of affairs not improbable when we reflect that the family was originated on this continent.

Technically, perhaps, Teleoceras should not be considered as generically distinguishable from Rhinoceros, and had it been found in Europe it would doubtless have been referred to that genus. Since however it is an American form, found in the same beds with Aphelops, its unmistakable ancestor, which latter as has been shown by Cope, Scott and Osborn, is quite distinct from Rhinoceros, I have decided to refer it to a distinct genus; believing that classification should rest so far as possible upon our knowledge of actual relations, and should

be an expression of those relations so far as they are understood and not a mere set of conveniences, based entirely upon the presence or absence, and similarity or dissimilarity of parts.

GEOLOGY OF THE REGION.

In the immediate region in which the collections were made, only two distinct geological horizons appear on the surface, these are the Loup Fork and Equus beds. None of the water courses have here succeeded in entirely removing the Loup Fork, and exposing the underlying older strata. The Loup Fork beds consists of light colored, calcareous sandstones, somewhat loosely cemented, resembling in color and friability, old mortar. They are everywhere penetrated by numerous calcareous rods or tubes, probably the casts of root-stocks of aquatic plants. They dip very gently to the southeast which is evidenced by the fact that the southern slopes are gentle, while those looking northward are abrupt. Where they have not been entirely removed by erosion, the Equus beds unconformably overlie the Loup Fork beds. This unconformity has been overlooked by all previous explorations in this region. Marsh makes no mention of it in reporting on his expedition into this very place in 1872; and in his subsequent descriptions of vertebrate fossils from these beds, he has not distinguished between them, although their respective faunas are really quite distinct, and the beds themselves are not the result of a continuous sedimentation from the commencement of the one to the close of the other; but there was an important break at the close of the Loup Fork when this region became dry land, and remained such through a long period of time, after which the Equus beds were deposited upon the eroded surface of the Loup Fork.

The Equus beds are composed of loose, incoherent sands, except for occasional layers of somewhat tough, gritty clays. The rapidity with which they yield to erosion, and their generally incoherent nature has greatly aided in concealing their exact statigraphic relations to the underlying beds. In

almost all exposures the exact contact is concealed by a *tatus* from the upper beds. In several instances, however, the true relations were easily determined and one, which presented particularly favorable conditions is represented here in fig. 2. It represents a short section of the east side of one of the main 'draws' emptying into the Niobrara river. At this point this small water course has cut directly across the bed of a similar water course eroded out of the surface of the Loup Fork and since filled by the Equus beds. At this same point there enters the main 'draw' a small tributary from the east, and the combined currents of these two water courses, although entirely dry except immediately after heavy rains, have sufficed to keep the actual contact apparent. At lf. appear the nearly horizontal Loup Fork strata with their characteristic fossils, *Aphelops*, *Aelurodon*, *Procamelus*, *Protohippus*, *Mastodon*, etc. At eb. the Equus beds are seen resting unconformably upon the Loup Fork beds at an angle of about 15° and containing fossils characteristic of these beds, *Equus*, *Elephas*, *Mylodon*, *Canis*, etc.; al. represents the recent deposits in the bottom of the "draws," all below the top of this line is imaginary. On the opposite side of the main draw the same conditions are seen at the bottom, but toward the top the contact is not so apparent, since there is on this side no tributary to aid in keeping the exposure free from talus.

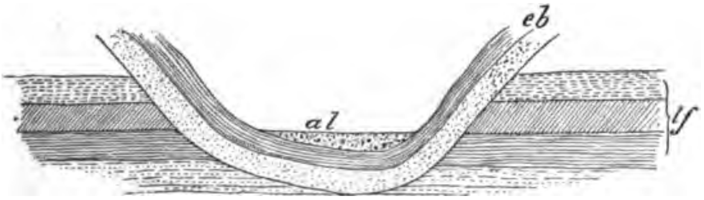


FIG. 2.

The figures in the plates and the text accompanying this paper were executed by Mr. Rudolph Weber. To the various members of the expedition, whose liberality made it possible, the authors best thanks are especially due.

Explanation of Plates.

Plate I.

Fig. 1. Side view of *Teleoceras major*, n. end of nasals.

1^a. Bottom view of *Teleoceras major*, n. end of nasals, pn. posterior nares.

1. Front view of nasal horn of same.

1^c. Top view of nasal horn of same.

Fig. 2. Side view of lower jaw of *Aelurodon taxoides*, amf. anterior mental foramen, pmf. posterior mental formen.

2^a. Crown view of same; pa^d, paraconid, pr^d. protoconid, hy^d. hypoconid, me^d. metaconid, en^d. entoconid.

Plate II.

Fig. 1. Side view of temporal region of *Rhinoceros sondaicus* (after Flower), mae. meatus auditorius externus, pg. post-glenoid process, pt. post-tympanic process.

Fig. 2. Side view of temporal region of *Teleoceras major*.

Fig. 3. Side view of temporal region of *Aphelops fossiger*.

Fig. 4. Side view of temporal region of *Ceratorhinus sumatrensis*.

Fig. 5. Second, left upper molar of *Aphelops fossiger ?* crs. crista, acr. anticrochet, ps. posterior sinus.

Fig. 6. Second, left upper molar of *Teleoceras major*, crs. crista, acr. anticrochet, cr. crochet, ms. median sinus, as. anterior sinus, pf. posterior fossette.

Fig. 7. Second, left upper molar of *Rhinoceras sansaniensis* (after Filhol), ps. posterior sinus, pv. posterior vallum.

Fig. 8. Second, left upper molar of *Aceratherium occidentale ?* letters as in fig. 6.

Fig. 9. Second, left upper molar of *Ceratorhinus sumatrensis*, cr. crochet, pv. posterior vallum.

EDITORIALS.

—The postoffice department at Washington adopted last year a new style of letter box for cities, which has generally replaced the old ones. This change has been for the worse in one important respect. While the boxes of the new pattern afford better protection from thieves, they are unfit for the reception of second and third class matter generally. The opening is too small, and the fore and aft diameter is too narrow to receive the greater part of such matter. In the attempt to use these boxes for such matter, it is apt to be injured, but usually it cannot be inserted. As the new boxes were not, we learn, intended to exclude such matter, they show a lack of intelligence on the part of both the designer and the department. The old boxes are much more useful, but a new box of the modern pattern, with a wider gape and deeper throat, would be better still. Editors and publishers would be much accommodated by such a change. This would be an improvement much more important than most of the novelties introduced by the last administration of the postoffice department.

—The International Congress of Zoologists of 1892, was held at Moscow, and was an occasion of much interest. Many important papers were read, a majority of them naturally having reference to various parts of the vast territory under the dominion of the Czar. A peculiar feature of the volume issued by the Congress, which embraces the papers read or abstracts of them, is that it contains a full page portrait of the Grand Duke Serge Alexandrowitch in military costume, as a frontispiece. Below the portrait is a fulsome expressiom of "veneration and thanks" for aid rendered the Congress by "his imperial highness." This strikes us as strangely out of place in a zoölogical work, and not less so because the Congress was "international." The singing of the Russian national hymn, with which the last session of the Congress was closed, can hardly be regarded as an "international" zoölogical ceremony.

—The conduct of the authorities of the Chicago Exposition since its close, has not been characterized by that care for the property of the exhibitors and others necessarily under their charge, which should characterize an honorable corporation. The buildings have been left insufficiently guarded, and tramps have had full opportunity to perpetrate mischief. Among these, incendiary fires have been conspicuous,

so that damage has been done to the property of exhibitors, and many narrow escapes have been made. The dismantelment of the fire apparatus has rendered the situation all the more dangerous. Finally the quarters for the shelter of the strangers engaged in moving their exhibits have been rendered uninhabitable at an inclement season of the year. Altogether, the hospitality of Chicago to exhibitors and national commissions has been scanty, and this part of the exposition management does not redound to the credit of the city. It is in marked contrast to that which has characterized the expositions held elsewhere in both Europe and America.

—THE closing of the Allis Biological Laboratory at Milwaukee, is much to be regretted, but as it is due to the financial stringency, it is to be hoped that, with the return of more prosperous times, it will be reopened by its public-spirited and scientific founder.

RECENT BOOKS AND PAMPHLETS.

ALLEN, J. A.—On a Collection of Mammals from San Pedro Martir Region of Lower California, with notes on other species, particularly of the genus Sitomys. Extr. Bull. Am. Mus. Nat. Hist., Vol. V, 1893. From the author.

ANDREA. DR. A.—*Acrosaurus frischmanni* H. V. Mey. Sonderabdruck aus Ber. d. Senck Naturf. Gesell. in Frankfort, A. M. 1893. From the author.

BEECHER, C. E. AND SCHUCHERT, C.—Development of the Brachial Supports in Dielasma and Zygospira. Extr. Proceeds. Biol. Soc., Washington, 1893. From the authors.

BIRKINBINE, J.—The Production of Iron Ores, 1892. Extr. Min. Resources of the U. S., 1892. From the U. S. Geol. Surv.

BOETTGER, DR. O.—Bericht über die Leistungen in der Herpetologie während des Jahres 1889. From the author.

Bulletin No. 50, 1893, Massachusetts State Agri. Exper. Stat.

Bulletin No. 25, 1892, Texas. Agri. Exp. Stat.

Bull. No. 29, 1893, U. S. Dept. Agri. Div. of Entomology.

CARUS, P.—The Philosophy of the Tool. Chicago, 1893.

——Le Problème de la Conscience dui Moi. Paris, 1893.

——The Religion of Science. Chicago, 1893. From the author.

CHAPMAN, H. C.—Observations on the Japanese Salamander. Extr. Proceeds. Phila. Acad. Nat. Sci., 1893. From the author.

CHAPMAN, H. C., AND BRUBAKER, A. P.—The Radius of Curvature of the Cornea. Extr. Proceeds Acad. Nat. Sci., Phila., 1893. From the author.

COMSTOCK, J. H.—Evolution and Taxonomy. An Essay on the application of the theory of Natural Selection in the Classification of Animals and Plants, illustrated by a study of the wings of insects and by a Contribution to the Classification of the Lepidopteria. Reprint from the Wilder-Century Books, 1893. From the author.

DAVENPORT, C. B.—On the Development of Cerata in Æolis. Extr. Bull. Harv. Mus. Comp. Zool., Vol. XXIV, 1893. From Alexander Agassiz.

DE VIS, C. W.—Note on the Upper Incisor of Phascolonus. Extr. Proceeds. Linn. Soc., New South Wales, 1893. From the author.

DOUVILLE, H.—Revue de Palèontology pour l'annèe, 1891. Extr. l'Annnaire Gèol. Univ., Tome VIII, 1892–93. From the author.

DUGES, A.—Variaciones de Coloracion en el *Gerrhonotus imbricatus*. Extr. La Naturaleza, 2nd Ser. T. II, 1893. From the author.

FAIRCHILD, H. L.—Proceeds. of the Fifth Summer Meeting of the Geol. Soc. Am., Aug., 1893. Extr. Bull. Geol. Soc. Am., Vol. 5, 1893. From the Soc.

FERRIER, W. F.—Catalogue of a Stratigraphical Collection of Canadian Rocks prepared for the World's Columbian Exposition, Chicago, 1893. Ottawa, Canada, 1893. From the Canadian Geol. Surv.

——Notes on the Microscopical Character of some rocks from the Counties of Quebec and Montmorency. No date given. From the author.

Fifth Annual Rept. of the Texas Agri. Exp. Stat., 1892.

Fish, P. A.—Brain Preservation, with a Résumé of some old and new methods. Reprint from the Wilder-Century Book. From the author.

Gerrish, F. H., and Ballock, E. A.—Uniformity in the Division of the Abdominal Regions. Extr. Boston Med. & Surg. Journ., 1893. From the authors.

Hedley, C.—The Range of Placostylus; A Study in Ancient Geography. Extr. Proceeds. of the Linn. Soc. of New South Wales, 1892. From the author.

Hollick, Dr. F.—The Old Quarantine. Its Destruction and the Causes that led to it. Extr. Proceeds. Natl. Science Ass., Staten Island, Oct., 1893. From the author.

Holmes, W. H.—Vestiges of Early Man in Minnesota. Extr. Am. Geol., 1893. From the author.

Hopkins, G. S.—The Lymphatics and Enteric Epithelium of Amia Calva. Reprint from the Wilder Quarter-Century Book, 1893. From the author.

Hyatt, A.—Bemerkimgen zu Schultze's System einer descriptiven Termiologie. Sonderabdruck aus Biol. Centralb., Aug., 1893.

——Biopla-tology and the Related Branches of Biologic Research. Extr. Proceeds. Boston Soc. Nat. Hist., Vol. XXVI. From the author.

James, E. J.—Education of Business Men in Europe. New York, 1893. From the author.

Julien, A. A.—Suggestions in Microscopical Technique. Extr. Proceeds. New York Micros. Soc., 1893. From the author.

Kilborne, F. L., and Others.—Miscellaneous Investigations concerning Infectious and Parasitic Diseases of Domesticated Animals. Bull. No. 3, Bureau An. Ind. U. S. Dept. Agri. From the Dep't. Agri.

Kingsley, J. S.—The Embryology of Limulus (Part II). Reprint Journ. Morph. Vol. VIII, 1893. From the author.

Lebedeff, N.—Obersilurische Fauna des Timan. Extr. Mem. de Comité Geol., Vol. XII, 1892. From the author.

Logan, W. S.—The Siege of Cuautla. An Address before the New York Hist. Soc., April, 1893. From the author.

MacDonald, A.—Abnormal Man. Cir. Inform. No. 4, 1893, Bureau Ed. From the Bureau Ed.

McGuire, J. D.—Art of Working in Stone. Extr. Am. Anthrop, 1893. From the author.

Merrill, G. P.—Report upon Rocks collected from the Galapagos Islands. Extr. Bull. Harv. Mus. Comp. Zool., Vol. XIV, 1893. From Alexander Agassiz.

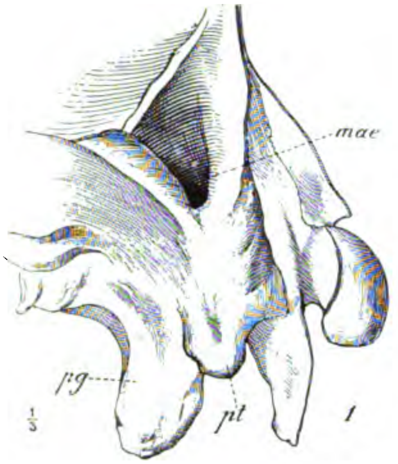
Moore, V. A.—The Character of the Flagella on the Bacillus *Cholerae suis*, *B. coli communis* and *B. typhi abdominalis.* Reprint from the Wilder Quarter-Century Book, 1893. From the author.

Ordonez, J. G. A. Y. E.—Datos para la Geolgia de México. Extr. Cosmos Costado del Ex. Arzobispado num. 1, 1893. From the author.

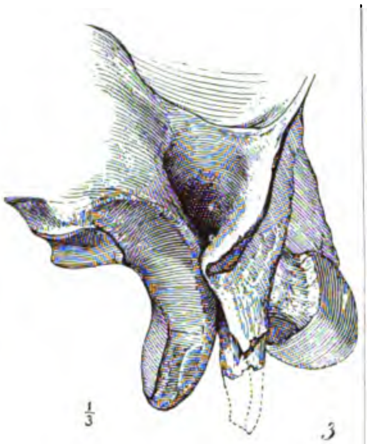
Penrose, R. A. F.—A Pleistocene Manganese Deposit near Golconda, Nevada. Extr. Journ. of Geol., 1893. From the author.

Proceedings of the Second Joint Meeting of the Scientific Alliance of New York in Memory of Professor John S. Newberry, March 27, 1893.

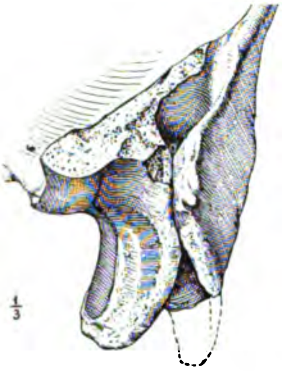
Report of the Committee on Classification of Methods of Instructing the Deaf. Washington, 1893.



1

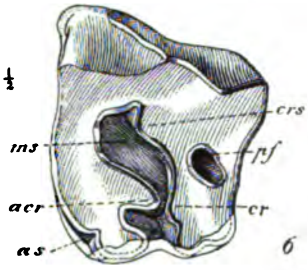


3

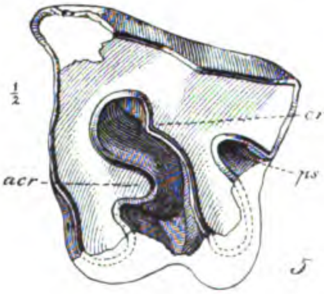


2

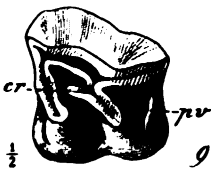
4



6

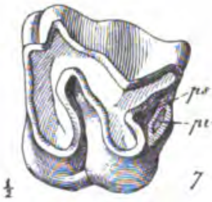


5



9

8



7

R. WEBER, DEL.

Rhoads, S. N.—The Hudsonian Chicadee and its Allies, with Remarks on the Geographic Distribution of Bird Races in Boreal America. Extr. Auk, Oct., 1893. From the author.

Rockwell, J. E.—Shorthand Instruction and Practice. Cir. Inf. No. 1, 1893, Bureau Ed. From the Bureau Ed.

Schuchert, C.—On the Development of the Shell of *Zygospira recurvirostra*. Extr. Proceeds. Biol. Soc., Washington, 1893. From the author.

Shinn, M. W.—The Leland Stanford Junior, University. . Extr. Overland Monthly, Oct., 1891. From the author.

Slocum, H. A.—A Problem in Abdominal Surgery; Why is the Uterus retained after the Ovaries are removed? Extr. Medical News, Oct., 1893. From the author.

Spencer, J. W.—The Paleozoic Group. The Geology of Ten Counties of Northwestern Georgia and Resources Atlanta, Georgia, 1893. From the author.

Stehlin, H. G.—Zur Kenntniss der Postembryonalen Schädelmetamorphosen bei Wiederkauern. Inauguraldissertation zur Erlangung der Doctorwürde einer hohen Philosophischen Facultät der Universität Basel. Basel, 1893. From the author.

Tenth Annual Report of the Board of Control of the State Agricultural Exp. Station. 1892.

Test, F. C.—The Gopher Frog. Extr. Sci., Aug., 1893. From the author.

Twenty-seventh Annual Report on the Colonial Museum and Laboratory. New Zealand, 1893.

Walker, F. A.—The Technical School and the University. Extr. Atlantic Monthly, Sept., 1893——Remarks on the Dedication of the New Science and Engineering Buildings of McGill University, Montreal. Extr. Tech. Quart., Vol. VI, 1893. From the author.

Ward, C. J.—Jamaica at Chicago. An Account Descriptive of the Colony of Jamaica. New York, 1893. From Mr. Ward.

Whiteaves, J. F.—Notes on the Gasteropoda of the Trenton limestone of Manitoba, with a description of one new species. Reprint Can. Rec. Sci., 1893. From the author.

Woodward, M. F.—On the Development of the Teeth of the Macropodidae. Extr. Proceeds. Zool. Soc. London, 1893. From the author.

RECENT LITERATURE.

The Canadian Ice Age.[1]—This volume, an octavo of 300 pages, is a compilation of observations bearing upon the history of the northern half of the North American Continent during the Ice Age, recorded by Sir Wm. Dawson since 1855. The generalizations are not extended beyond the Canadian border, but the author's conclusions deny the possibility of large accumulations of land ice on an interior continental plain, south as well as north of the Canadian boundary. In fact, at that time, according to the author, there was no interior plain. An ideal map of Canada during the Plistocene Age, shows the northern half of the continent to consist of three large mountainous islands, the Cordilleran, the Laurentide, and the Appalachian, with Greenland to the north, surrounded by ice ladened seas and straights. These islands were the gathering-grounds of the snow and ice that, in the form of glaciers and icebergs, were such powerful agents in modifying the topography of the continent. The ice movement on these islands appeared to be outward in all directions from a central axis or plateau, analagous to what is taking place in Greenland at the present day. The "Terminal Moraine" of the glacialists represents the shore line of the ice-ladened sea where floe-ice and bergs grounded with their burden of boulders and other débris. Anomalies in the levels of the so-called terminal moraine are due to differential elevation. The author gives a résumé of the the present knowledge of the glacial movements during the Plistocene period, as shown by the striae, and the conditions under which the Boulder-drift of Canada was deposited as proofs of the above theory.

The succession of deposits is treated of at length, and the subject is summarized in tables of succession and correlation. In an ascending order the strata are (1) a lower boulder clay or till resting on heavily striated rock surface, representing shallow water deposit; (2) Leda clay, the greater part of which, from the evidence of its fossil contents, was laid down in water from 20 to 100 fathoms deep; (3) surface boulders.

In regard to the striae, the author makes the following general statement as to the agents producing them:

---

[1] The Canadian Ice Age. Being Notes on the Plistocene Geology of Canada, with especial reference to the Life of the Period and its Climatal Conditions, and lists of the specimens in the Museum. By Sir J. Wm. Dawson. Montreal, 1893.

"In summing up this subject, it may be affirmed that when the striation and transfer of materials have obviously been from N. E. to S. W., in the direction of the Arctic current, and more especially when marine remains occur in the drift, we may infer that floating ice and marine currents have been the efficient agents. Where the striation has a local character, depending upon existing mountains and valleys, we may infer the action of land ice. For many minor effects of striation, and of heaping up of moraine-like ridges, we may refer to the presence of lake or coast ice as the land was rising or subsiding."

Again, "Sea glaciation is always accompanied with much smoothing and polishing, and on very hard rocks the striation is comparatively imperfect, while it is not quite uniform in direction and often presents two sets of striae. The action of true land glaciers, especially when moving down considerable slopes, produces deep grooves, as well as striae, on vertical as well as on horizontal surfaces, and is more fixed and uniform."

The summary of fossils given in Chapter VI, comprises 240 species, of which 33 are plants; the rest are distributed as follows: Protozoa, 21; Echinodermata, 7; Mollusca, 142; Vermes and Arthropoda, 30; Vertebrata, 7. From both flora and fauna the author infers an amelioration of the climate, resulting, in his estimation, from the gradual elevation of the land which threw the Arctic currents from its surface, exposed a larger area to the direct action of solar heat, and probably determined the flow of marine currents so that the heavy northern ice was led out into the Atlantic instead of being drifted southwest over the lower levels of the continent.

The leading thoughts in this collection of papers is the relative value of land ice and water-borne ice as causes of geological change during the Plistocene period. These two agents, together with the complex elevations and depressions of the continent as shown by the deposits and their fossil contents account for the effects observed.

This paper is an important one, and will probably correct the extravagancies into which the past glacialists have fallen.

The Mollusc-Fauna of the Galapagos Islands.[2]—The molluscan forms collected by Professor Leslie A. Lee and his assistants, on the voyage of the U. S. Fish Commission Steamer Albatross, from

---

[2] Scientific Results of Explorations by the U. S. Fish Commission Steamer Albatross. No. XXV. Report on the Mollusk-fauna of the Galapagos Islands, with Descriptions of New Species. By Robert E. C. Stearns, Ph. D. Adjunct Curator of the Department of Mollusks. Proc. U. S. Nat. Mus., Vol. XVI, (1893) pp. 353-450, with plate and map.

Chesapeake Bay by the way of the Strait of Magellan to San Francisco in 1887–88, is the basis of this paper which is, as will be seen in the foot-note, a report on the Galapagos material belonging to this division of the animal kingdom. As the author states in the text, it "refers, so far as the marine molluscs are concerned, with a few exceptions, to the littoral and shallow-water species only." The deep sea material remains to be investigated and reported on hereafter, though a few species described by Dall are included in the list, in the later part of the report.

The geographical and physical characteristics of the islands, their climatology and floral aspect, the distances and depths of the water between them, their origin, and the views of Darwin, Hooker, Wallace, Agassiz, Baur, etc., hereon are briefly presented. The origin of the fauna and the flora is discussed, and in this connection the distribution of terrestrial and marine forms, etc., by oceanic currents, drift lodgement, freshets, and the agency of rivers, and the aerial distribution of animal and plant life, as well as the generative capacity and vitality of land snails, their ability to exist a long time without food, of which numerous instances are given, and the tenacity of life in many species that have been observed, are all referred to and treated at considerable length.

The author favors the *volcanic theory* of the region of these islands as held by the majority of scientific writers, rather than that of Dr. Baur and Milne-Edwards, who regard the Galapagos as "*Continental Islands originated through subsidence*," a conclusion based principally on biological evidence, etc.. as exhibited in their peculiar fauna and flora.

The number of molluscan species and varieties obtained by the Albatross collectors was 120, of, these 7 species and 9 varieties were terrestrial forms. Four new species are described, and one of these is a land shell, *Bulimulus* (*Pleuropyrgus*) *habelii*; the others are *Onchidium lesliei*, *Nitidella incerta*, and *Tectarius galapagoensis*.

As a part of the report, the late Dr. Philip Carpenter's list of the Galapagos species contained in Reeve's Monograph's is given, also Albers' list of Galapagos *Bulimi*; the Petrel-Cookson shells, as determined by E. A. Smith of the British Museum; Wimmer's list of Habel's collection; Ancey's species, and Reibisch's list of species collected by Dr. Theodor Wolf, State Geologist of Ecuador; Dr. W. H. Jones' Chatham Island shells, Dall's recently described Galapagos species, including a few deep water forms, a part of the Albatross dredgings, and a few land species collected by Dr. Baur.

Following the above the author has added a systematic list, summarized from the preceeding authorities. This compilation, which will be found very convenient by the student, shows a total of 318 species and varieties; of these 48 species and varieties are terrestrial and the others marine. Of the latter, 61 are Lambellibranchs and 1 Scaphopod; 205 species and 13 varieties are Gastropods.

Of the marine species the author says, "Less than a half score are indigenous, of these, some, if not all, may prove, upon a better knowledge of the molluscs of the shores of Central and South America, to belong to the mainland." A comparison is suggested of *Omphalius cooksonii* Smith, with the Antillean *O. fasciatus.* The number of species that exhibit intimate relationship with Antillean-Carribean forms is quite small and in conspicuous when placed side by side with the American types; the latter include nearly all the species contained in the summarized list.

The author observes that the land shells are of a distinctly West South American aspect, and a comparison is suggested with several species named, which occur in Bolivia, Peru and Chili, rather than to the peculiar forms inhabiting Ecuador and other South and Central American States further north.

In several instances the erroneous determination of marine species or varieties of the same, that have been made by various authors resulting in the accrediting of Indo-Pacific forms to the Galapagos Islands, have been pointed out and explained. The report closes with a plate containing figures of the species described, and the map of the Galapagos islands.—CHAS. T. SIMPSON.

An Examination of Weismannism.[3]—The several chapters comprised in this volume have been written at successive intervals during the last six or eight years, as Professor Weismann's works have appeared, so that this discussion by Mr. Romanes presents a clear view of the growth of the Weismannian theories. Three chapters are devoted respectively to Weismann's system up to the year 1886—to the year 1892—to the year 1893. Of the two remaining chapters, one is a discussion of Weismann's theory of heredity (1891), the other is a critical examination of Weismann's theory of evolution (1891). Two appendices entitled "On Germ Plasm and On Telegony" complete the volume.

In conclusion, the author refers to the fundamental changes which Professor Weismann has wrought in his general system of theories by

---

[3] An Examination of Weismannism. By George John Romanes, M. A., LL.D., F. R. S. Chicago, 1893. Open Court Publishing Co.

the publication of his more recent works, and closes with the following remarks:

"Thus, the Weismannian theory of evolution has entirely fallen to pieces with the removal of its fundamental postulate—the absolute stability of germ-plasm. It only remains to mention once more the effects of this removal upon the other side of his system, viz., the companion postulate of the uninterrupted continuity of germ-plasm, with its superstructure in his theory of heredity."

Briefly, these effects are as follows:

"1. Germ-plasm ceases to be continuous in the sense of having borne a perpetual record of congenital variations from the first origin of sexual propagation.

"2. On the contrary, as all such variations have been originated by the direct action of external conditions, the continuity of germ-plasm in this sense has been interrupted at the commencement of every inherited change during the phylogeny of all plants and animals, unicellular as well as multicellular."

"3. But germ-plasm remains continuous in the restricted, though still highly important sense, of being the sole repository of hereditary characters of each successive generation, so that acquired characters can never have been transmitted to progeny "representatively," even although they have frequently caused those "specialized" changes in the structure of germ-plasm which, as we have seen, must certainly have been of considerable importance in the history of organic evolution."

"4. By surrendering his doctrine of the *absolute* stability of germ-plasm on the one hand, and of its *perpetual* continuity on the other, Weismann has greatly improved his theory of heredity. For, whatever may be thought of his recent additions to this theory in the way of elaborate speculation touching the ultimate mechanism of heredity, it is a great gain to have freed his fundamental postulate of the continuity of germ-plasm from the two further postulates which have just been mentioned, and the sole purpose of which was to provide a basis for his untenable theory of evolution."

"5. In my opinion, it only remains for him to withdraw the last remnant of his theory of evolution by cancelling his modified and even less tenable views on amphimixis, in order to give us a theory of heredity which is at once logically intact and biologically probable."

"6. The theory of germ-plasm would then resemble that of stirp in all points of fundamental importance, save that while the latter leaves open the question as to whether acquired characters are ever inherited in any degree, the former would dogmatically close it, chiefly on the

grounds which I have considered in Appendix II. It seems to me that in the present state of our knowledge, it is more prudent to follow Galton in suspending our judgment with regard to this question, until time shall have been allowed for answering it by the inductive methods of observation and experiment."

"7. Hence, in conclusion, we have for the present, only to repeat what Weismann himself has said in one of the wisest of his utterances: 'The question as to the inheritance of acquired characters remains, whether the theory of germ-plasm be accepted or rejected.'"

"It is now close upon twenty years that I have accepted the substance of this theory under the name of stirp; and since that time the question as to the inheritance of acquired characters remains exactly where it was. No new facts, and no new considerations of much importance, have been forthcoming to assist us in answering it. Therefore, as already stated in the preface, I intend to deal with this question hereafter as a question of *per se*, or one which is not specially associated with the labors of Professor Weismann."

The theory entitled by Romanes by the name of "stirp," was tentatively suggested by Galton in 1875, and was more distinctly enunciated in the AMERICAN NATURALIST for 1889, under the head of Diplogenesis. An acceptance of it is to be found in the article by vom Rath which is republished in the January NATURALIST. It is evident that the diversity in the views of biologists as to the inheritance of acquired characters is becoming more verbal than real.

Extinct Monsters.[4]—In this book of some 250 pages Mr. Hutchinson has endeavored to give a popular account of some of the larger forms of extinct animals, and has illustrated the several chapters with drawings of restorations of them. These drawings are commended to the public by Dr. Henry Woodward, who pronounces them, in a preface, "the happiest set of restorations that has yet appeared."

The author devotes seven of the sixteen chapters to the Saurians, drawing upon the discoveries in the United States for much of his material. Under the head of Sea-Scorpions many points of interest concerning Pterygotus and its allies are given. American Mammals are represented by one species from the Eocene, one from the Neocene, and one from the Plistocene. From the varied Sivalik fauna of India, the author chooses Sivatherium and *Testudo atlas*, and from South America the characteristic Sloths and Glyptodons. The remaining

---

[4] Extinct Monsters. A Popular Account of Some of the Larger Forms of Ancient Animal Life. By Rev. H. N. Hutchinson, with illustrations by J. Smit. London, 1893, Chapman and Hall, Publishers.

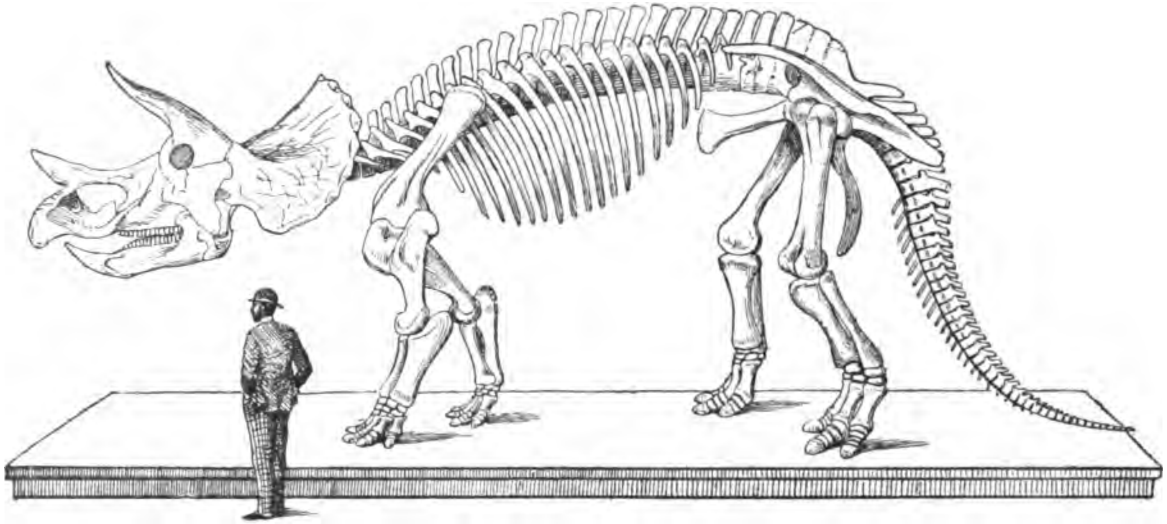


FIG. 1. *Agathaumas flabellatus*. Skeleton. From Marsh.

From the Laramie of N. America.

FIG. 2. Camarasaurus, from the Juarssic of North America.

chapters describe the Mammoth, the Mastodon and the Wooly Rhinoceros, Some Giant Birds, the Irish Elk and Steller's Sea-Cow.

In the appendices reference is made to the recent discoveries by Dr. Fraas of the structure of the dorsal and tail fins of *Ichthyosaurus tenuirostris*, and to Mr. Henry Lee's discussion as to the existence of the great Sea-Serpent. Here also is given a list of British localities where mammoth remains have been found.

The book is written in an entertaining style, and it is likely to interest the lay reader in the subject. That it will have considerable effect in extending a knowledge of the extinct forms of animal life there can be no doubt. Meanwhile it is a pity that the author did not consult some one familiar with the subject, who could have given him the correct nomenclature of some of the forms which he portrays. Thus the so-called Stegosaurus was previously named Hypsirhophus; and paleontologists who have seen both, allege that the name Brontosaurus was given to the reptile previously named Camarasaurus. It is probable that Triceratops is Agathaumas, which was named and described fourteen years before the former name was given. It would have been better to have given a restoration of the *Loxolophodon mirabile* Marsh, rather than one of the *L. ingens;* since a skeleton of the former is known, while none of the latter had been obtained at the time the so-called restoration was made. We understand that a second volume is in preparation, which will contain other forms not included in the one under review. There is a fine field yet open in this direction, and we hope that Mr. Hutchinson will be able to take advantage of it. We owe to the courtesy of the publishers the opportunity of presenting two of the illustrations.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Trans-Pecos Texas.—The studies of Mr. Streeruwitz in western Texas have developed some interesting facts from both a scientific and economic standpoint. The rocks are mostly older and newer eruptives and various metamorphics; the sedimentary, as now known, reach from the Silurian to the Cretaceous period, and Cenozoic deposits are probable. The petrography of the Igneous rocks has been reported upon by Mr. A. Osann in the Ann. Rept. for 1892, Geological Survey of Texas. The results of his examinations show the great diversity of the character of the rocks prevailing in the different mountain ranges and the great difference in time and conditions of their origin.

Mr. Streeruwitz finds that the disintegration of the rocks in Trans-Pecos Texas is mostly the result of the rapid changes of temperature and deflation, the same forces active in the desert of Sahara. The rains are also the cause of another source of disintegration causing that peculiar shape of granite blocks peculiar to the Sahara called "Pilzfelsen." Chemical action manifests itself in the formation of rows of caves in the stratified granular rocks similar again to the African deserts.

The prevalence of ozone in West Texas is explained by the author as the result of the friction of the drifting sand grains among themselves and along the surface of the soil and the rocks, which creates sufficient electricity to ozonize the oxygen of the atmosphere.

In regard to the ores, Mr. Streeruwitz reports that the most of the mountain ranges of Trans-Pecos Texas are ore-bearing. These ores are of excellent quality and exist in paying quantities, along with building stones and material for art and decorative work, not to mention agates, sardonyx, opals and other precious stones. The difficulties in the way of mining these products are pointed out and ways of surmounting them suggested by the writer. Under existing conditions the mountain land of this region is practically valueless, and for lack of irrigation the flats are becoming less fertile from year to year. (Fourth Ann. Rept., 1892, Geol. Surv. Texas, Austin, 1893.)

Estimates of the Duration of the Glacial Epoch.—At a recent meeting of the Geological Society of America, Mr. Warren Upham

showed by a comparison of the shore erosion and accumulation of beach gravel and sand by the waves of Lake Agassiz with those of Lake Michigan that the existence of the former might be estimated at not more than 1000 years; the moraines belonging to the area of the later drift were probably formed in twice that time; the recession of the ice from its outermost limit to the first of these moraines a similar length of time, or perhaps, longer. In these conclusions the author agrees with Prestwich, who estimates the epoch of extreme cold at 15,000 to 25,000 years, and the melting of the ice-sheet to from 8,000 to 10,000 years or less.

In order to show that his conclusion as to the age of Lake Agassiz is consistent with the known records and inferred conditions of the Ice age upon the central belt of the North American continent, Mr. Upham reviews the series of formations in the Mississippi and Nelson river basins which belong to the times immediately preceding, during and following the Glacial period, especially considering the changes in the altitude and slopes of the land and the probable measures of time demanded by the processes of drift transportation and deposition, by subsequent weathering with soil formation, and stream erosion. As a result of his investigations, he gives the following estimates of the duration of the three parts of the Cenozoic period under study, arranged in chronological order:

"The time of preglacial epeirogenic elevation, with the deposition and erosion of the Lafayette beds, some 60,000 to 120,000 years; the Glacial period, regarded as continuous, without interglacial epochs, attending the culmination of the uplift, but terminating after the subsidence of the glaciated region, 20,000 to 30,000 years, and the Postglacial or recent period, extending to the present time, 6000 to 10,000 years. In total the Plistocene era in North America, therefore, has comprised probably about 100,000 or 150,000 years, its latest third or fourth part being the Ice age and subsequent time. The pre-plistocenic Cenozoic era appears by changes of its marine molluscan faunas to have been vastly longer, having comprised, perhaps, between two and four million years, of which the Pliocene period would be a sixth or eighth part, thus exceeding the whole of the ensuing era of great epeirogenic movements and resulting glaciation."

In the discussion which followed the reading of Mr. Upham's paper, Mr. McGee called attention to the unmistakable unconformity between the Columbia and Lafayette formations in the Coastal plain series. This unconformity represents erosion approaching 1000 feet in depth in the Lower Mississippi region and from 300 to 500 or more feet in depth in

the embouchures of the other rivers of the Coastal plain. It is represented not only by the removal of fully one-half of the original volume of the Lafayette formation, but by the degradation of an equal or greater volume of subjacent formations of Neocene, Eocene and Cretaceous age beneath. (Bull. Geol. Soc. Am., Vol. 5, 1894.)

In a previous publication in the same periodical, Mr. Upham had concluded that the observed volume of the Plistocene glacial erosion and resulting drift had probably accumulated in from 10,000 to 20,000 years. In the general conclusion of a short rather than a long period, Mr. R. S. Tarr agrees, but cannot accept Mr. Upham's line of argument, with our present knowledge of the rate of glacial erosion. Various complex factors make a time estimate of little value. Mr. Tarr bases his estimate on the following conditions.

A glacier is supplied with material for erosive work in three ways: (1) it may carry along the loose material in its path; (2) it may rend rocks asunder whenever a place of entry is found; (3) it may obtain material from the rock itself by scouring it with cutting tools already supplied. The erosive action of ice is to round, smooth and polish the surface over which it moves, lessening the possibility of obtaining a supply of cutting tools, so that as the period of ice occupancy lengthens the power of erosion diminishes.

With these facts as a basis, a young glaciated region should be littered with glacial drift, the products of disintegration. In a later stage the deposits would be composed of fresher rock fragments distributed in greatest abundance near the periphery of the ice-sheet. During old age the country would be free from deposits and the topography would consist of polished, rounded hills of glacial erosion. The first stage would be brief, the second longer, and the passage to extreme old age one of slow development.

In accordance with these facts, Mr. Tarr concludes that the North American glaciated region is topographically young, or at most not far advanced into maturity. (Am. Geol., Vol. XII. 1893.)

Geology of Marthas Vineyard.—After a personal investigation of the geology of Marthas Vineyard, Mr. Hollick finds that the ridge of hills consisting of a superstructure of contorted clay strata capped and flanked to the north with till, is composed of material derived from cretaceous and post-cretaceous strata. He does not agree with Shaler that the dislocations and elevations of the strata are due to mountain-building forces, but that they can be accounted for by the same theory that the author advanced for the modification of the strata

of Long Island and Staten Island which is to the south of former cretaceous areas, viz., that the clays have been eroded and ploughed up in masses, and the strata folded or squeezed up and shoved ahead by an advancing ice-sheet, which, upon melting, left them as hills or ridges of dislocated, contorted material covered by the englacial and super-glacial till. (Trans. N. Y., Acad. Sci., XIII, 1894.)

Plistocene Birds of Madagascar.—An important collection of bird bones from Madagascar has been received by the Academie des Sciences de Paris. According to MM. Milne-Edwards and Grandidier these bones indicate that at a period not remote, certainly contemporary with man, Madagascar was inhabited by 12 species, at least, of gigantic birds, incapable of flight, but provided with immense feet. Two types are distinguished: the first, Æpyornis, comprising 8 or 9 species; the second, named by the author Mullerornis, characterized by a lighter body, and a shorter tail than the first, comprises but 3 species. The conditions under which these bones were found shows that the bird lived on the shores of water, with troups of small hippopotami, crocodiles and turtles. (Revue Scientifique, Jan., 1894.)

Antennæ in Trilobites.—In the American Journal of Science, August, 1893, Mr. W. D. Matthew puts on record the important discovery of antennæ in *Triarthrus beckii*, and gives illustrations of a number of this species showing these appendages. The specimens were collected by Mr. Valiant in the Hudson River shales near Rome, N. Y. Walcott suspected an antennal system in the Trilobites, and looked for it by means of sections, but failed to find a trace.

In discussing this valuable addition to biological knowledge, Mr. H. M. Bernard (Nature, Oct. 12, 1893) refers to the appearance and position of the antennæ as described by Mr. Matthew and draws the following conclusions:

"(1) All trilobites had antennæ, which except, as far as we know, in the case of *Triarthrus beckii* alone, remained shut in under the head shield.

"(2) These ventrally placed antennæ were inserted, approximately, one on each side of the labrum.

"It seems to me that these natural conclusions from the facts go far to establish the relationship originally maintained by Burmeister, and recently elaborated by the present writer (The Apodidæ, Nature Series, 1892). But however weighty the arguments (amounting, it seemed to me, to a proof) in favor of this relationship, the inability actually to

demonstrate the existence of the antennæ was a felt weakness. That weakness has now been finally removed, and my arguments have been fully confirmed by the finding that the Trilobites had antennæ in practically the same position as the anterior pair in the Apodidæ.

"The Trilobites may, therefore, take a firm place at the root of the Crustacean system, with the existing Apus as their nearest ally."

Development of the Brachial Supports in Dielasma and Zygospira.—Some interesting results have been obtained by Messrs. Beecher and Schuchert in studying the development of the brachial supports of the Terebratellidæ. Some of the latest are embodied in a paper published in the Proceeds. Biol. Soc. Washington, 1893, in which the authors show that the most primitive form of the loop in the Ancylobrachia is centronelloid and that therefore Centronella represents a larval or immature condition of the higher genera. For demonstration the authors use the paleozoic species, *Dielasma turgida* and give drawings of six sections to show the development of the loop.

It is also shown that in *Zygospira recurvirostra* the primitive arm support is a terebratuloid loop having a Centronella form, which undergoes several modifications before the growth of the spiral lamellæ, in so far resembling the development of Dielasma. The spirals then develop as two slender converging lamellæ, curving toward the ventral valve, originating from the outer pointed ends of the loop. When maturity is attained there are about three volutions in each spiral cone. Sectional drawings illustrate this series of changes.

Zygospira is the earliest spire-bearing genus known, and from the study of the ontogeny and phylogeny of its species the authors conclude that the Ancylobrachia are older and more primitive than the Helicopegmata.

According to the authors these results throw doubt on a number of Lower and Upper Silurian species described as having recurved loops and previously referred to Macandrevia or Waldheimia. The facts indicate that *Waldheimia mawii*, described by Davidson, is the young of *Davia navicula* Sowerby.

Geological News.—MESOZOIC.—In a recent journey across the plateau of Shan-si, China, Mr. Obrucheff discovered some fossil plants in the middle parts of the series of deposits which cover in China, the carboniferous formation, and which Richthofen had described under the names of *Meberkohlen-sandsteine* or *Plateau-sandsteine*. These plants indicate that the middle portions of this formation belong to the Mesozoic age, and are Triassic or Liassic. (Nature, Jan., 1894.)

In a report on the Cretaceous area north of the Colorado Mr. J. A. Taff shows the detail of stratigraphy in four sectional views which give a concise view of the variations in thickness and structure and the relations of each division and formation to its associate divisions or formations, from the Brazos river on the south to the Red river valley on the north. Some attention is given to the soils of this region, and considerable definite information concerning the artesian water supply. The stratigraphic work is largely based on the paleontological determinations of Prof. F. W. Cragin.

Prof. Cope recently described two new species of Plesiosauroids from the Pierre formation of the Upper Cretaceous of South Dakota, under the names *Embaphias circulosus* and *Elasmosaurus intermedius*. The first named represents a new genus allied to Pliosaurus, having a short neck and strongly biconcave vertebræ. He also described the construction of the posterior part of the skull in another Plesiosauroid, the *Cimoliasaurus snovii* of Williston, showing that the supratemporal and supramastoid bones are both present and distinct. (Proceeds Amer. Philosoph. Soc.).

CENOZOIC.—As to the origin of certain hydrocarbons of Utah, Mr. M. E. Jones considers the theory of an animal origin advocated by Newberry to be the only tenable one. The deposits with one possible exception, are all either Eocene or Miocene, and their source, according to the author, being the overlying or adjacent bituminous beds. These remarks apply only to the deposits situated near the coal beds of Utah in the neighberhood of Pleasant Valley Junction. (Science Dec. 1893.)

ZOOLOGY.

The Irritability of Noctiluca.—M. Jean Massart has been conducting a series of experiments to ascertain to what stimulants the Noctilucæ respond, as shown by their phosphorescence, and to what extent the phosphorescence is modified by exterior agencies. The author finds that these organisms are sensitive (1) to a slight agitation of the water, (2) to sudden variations in the temperature and density of the water, and (3) to a great number of chemical substances. As to the first stimulant mentioned, the author discovered, by an ingenious experiment, that the agitation of the water produces a deformation of the body of the Noctiluca, and it is this deformation which causes the phosphorescence, and not a vibration transferred to the animal from the water in motion. The experiments testing the effect of certain volatile substances upon the organisms are exceedingly interesting. Amyline produces hyperesthesia, the light is more intense than in normal individuals. This condition lasts for five minutes, then all is dark. At a slight blow on the vessel the phosphorescence reappears, showing that sensibility has not been lost. Bromoform acts as an anesthetic. For about five minutes the Noctiluca subjected to its influence emit a feeble light which slowly fades out. At the end of twenty-five minutes the light is almost imperceptible; anesthesia persists. After twenty hours the normal state is recovered. The effect of acetone is similar, but more rapid in action. At the end of five minutes the phosphorescence disappears entirely, and at the end of twenty-eight minutes a slight tap on the vessel causes a diffused light, which persists for some seconds showing a return to the normal state.

Some substances produce anesthesia immediately, without any display of irritability (alcohol, methyl and paraldehyde); others result in the death of the organism without any luminous reaction (piperidine). Chlorhydrate of morphine and metaphosphate of sodium appear to have no effect upon the Noctiluca, which is astonishing since the latter substance is considered an energetic coagulant of the albuminoids.

While a slight agitation of the water containing Noctiluca increases the phosphorescent light, a violent shaking destroys it. This the author believes, is due to a blunting of the sensibility of the organism to the shock. A few minutes in quiet and darkness restores the animal to its normal irritability.

In general, the Noctiluca responds more readily to stimuli at night than in the day-time, and this is true even under artificial conditions. For instance, the record of one set of animals kept in the light from the beginning to the end of the experiment, and that of another kept in the dark is almost identical. M. Massart is inclined to attribute this regular variation of sensitiveness to memory on the part of the animal rather than to the influence of light, and his experiments would appear to prove his theory.

That the irritability of the Noctiluca varies with the temperature and density of the water is demonstrated in a few carefully conducted experiments, the results of which are given in tabulated form. Incidentally, M. Massart observed that the normal specific gravity of the the Noctiluca is 1.014, but that this is increased or lessened with the varying density of the water.

In conclusion, the author calls attention to the analogy between the irritability of the *Mimosa pudica* and that of the Noctiluca, the one manifesting itself in movement, the other by the emission of light. (Bull. Sci. de la France et de la Belgique, T. XXV, 1er Partie, 1893.)

The Production of Sound Among the Ants.—That ants have some means of communicating with each other is well-established. The experiments of Landois and those of Lubbock suggest that this communication is carried on by means of sounds produced and heard by these small creatures, but which the human ear is incapable of appreciating. The observations of M. C. Janet, published in *Ann. Entomol. de France* (Vol. LXII, p. 159) show that certain species of the Formicidae, notably *Myrmica rubra* L. and *Tetramorium cæspitum* L., are in the habit of making a stridulating noise, probably by reciprocally rubbing superficial parts of the body. A demonstration of this fact is very simple. On a small pane of glass put a ring of soft putty, and after carefully dropping in the middle of the ring, by means of a funnel, a mass of ants freed from bits of earth or vegetable matter, quickly cover them with a second pane of glass and press it down until there is just barely room between the two pieces of glass for the ants to move. If provision has been made for renewal of air the imprisoned ants will live for several days. On holding this little box of ants to the ear and listening attentively, a murmur is heard very similar to that made by a liquid boiling gently in a closed vessel, and before long distinct stridulations can be heard in the midst of the murmuring. These sounds are heard only when the ants are disturbed.

M. Janet concludes that the numerous rugose surfaces which are found on the body of ants in such places that two of them can be rubbed together, are probably the organs which produce the stridulating sounds of the Formicidae. These rugosities have other uses. For instance, those about the articulations serve to hold the body stiff at will at that particular point, an advantage to the animal in pushing or carrying heavy weights up steep slopes. (Revue Scientifique, January, 1894.)

Zoological News—MOLLUSCA.—Mr. J. I. Peck's report on the Pteropods and Heteropods collected by the U. S. Fish Commission steamer Albatross, during the voyage from Norfolk Va., to San Francisco, Cal., 1887–88, is published in the Proceeds. U. S. Natl. Mus., Vol. XVI. The material is the result of both dredging and surface collection. The Pteropods belong almost exclusively to the family Cavoliniidae, representing all the species except one of the genus Cavolinia, the species of Cuvierina, as also six of Clio. The Heteropods are included in the three genera Atlanta, Carinaria and Ianthina. According to the author, results show that there are no marked distinctions between the kinds and distribution in the Atlantic and Pacific waters of northern South America.

UROCHORDA—A new Tunicate from the Pacific Coast is described by Mr. W. E. Ritter, who assigns it to the genus Perophora. The new species presents an interesting character. In very many, though not all of the colonies, the ascidiozooids are as completely imbedded in a common test as they are in Botryllus or Goodsiria. In recognition of this transitional character the author proposes for it *annectens* as a specific name. (Cal. Acad. Sci., Vol. IV, 1893.)

MAMMALIA—Two new Neotomæ from the Plateau region of Arizona are described by C. Hart Merriam. One of the new species, *N. arizonæ*, presents a remarkable combination of the external characters of the bushy-tailed wood rats with the cranial characters of the round-tailed species. The other, *N. pinetorum*, is a round-tailed species allied to the *N. fuscipes* group of California. In this connection Mr. Merriam calls attention to an important cranial character, heretofore overlooked, which serves to distinguish *Teonoma* from *Neotoma*. In the skulls of the round-tailed wood rats there is a long open slit on each side of the presphenoid and anterior third of the basisphenoid. These openings the author designates the *spheno-palatine vacuities*. (Proceeds. Biol. Soc. Wash., 1893.)

EMBRYOLOGY.[1]

Cleavage and the Formation of Organs.—An important addition to the accumulations of experimental embryology has been recently made by Oscar Hertwig[2] in the hope of clearing up the fogs that envelop the important subject of the relations of the cells of a cleaving ovum to the subsequently formed organs of the adult.

While His, Roux and Weismann have seen in the ovum or germ a preformation of parts or organs and looked upon the cleavage cells as different in quality from the first, regarding the process of embryo formation as an evolution (in the old sense), Driesch and Hertwig, from experimental studies, now regard the ovum as *isotropic,* its first cells are qualitively alike, the embryology is an epiginetic formation of organs. The process is one of inter-relation of the cleavage cells.

In the present paper the author describes a long series of experiments made upon frogs' eggs and applies them to the overthrow of Roux's main position, meeting that investigator upon his own grounds.

The methods used are: the compressing of the eggs between glass slides placed horizontally, vertically or inclined; the compressing of the eggs by drawing them into narrow glass tubes placed horizontally or vertically; the partial separation of the first two cleavage cells (in the Triton) by means of a loop of fibre from a cocoon tied about the the egg; the injury of one of the first two cells by the insertion of a needle; and the same result by the use of an electric current, continuous or interrupted.

We will first give some of the chief facts obtained by each method and then the author's conclusions.

When the eggs lie in the normal position upon a glass slide but are compressed by the slide that rests upon them so as to be no longer spherical but considerably flattened, the main axis from the black to the light pole being thus made the shorter, by a third or a fourth, the eggs cleave in an abnormal manner. The third plane is not horizontal but more nearly vertical so that the first eight cells form a bilaterally symmetrical set of four on each side the second cleavage plane. Again, if the pressure is exerted upon the sides of the egg, which is done by plac-

---

[1] Edited by E. A. Andrews, Baltimore, Md., to whom communications may be sent.

[2] Archiv fr Mik. Anatomie. 42. 22 Dezember, 1893, pps. 662–794, Pls. 39–44.

ing the slide vertical and allowing the eggs to take up their normal position before the second slide is pressed upon them, the cleavage is abnormal. The second plane is not a vertical one but is horizontal so that two black-pole cells and two light-pole cells are formed. The two former cells are very small and divide up by somewhat vertical planes parallel to the first. Thus the second, normal, plane remains long absent. When the plates are inclined to 45° a still different modification of cleavage results.

The eggs that are drawn into narrow tubes are distorted into cylindrical or barrel-shaped masses that cleave abnormally. When the tube rests horizontally the first plane is vertical or normal but always at right angles to the axis of the tube, the second is normal, that is, at right angles to the first, but the third is also vertical and not horizontal: the fourth is horizontal.

When the tube is placed vertically the black part of the egg is uppermost and the cleavage is again altered by the pressure of the tube. The first plane is oblique and variable, but divides off a smaller upper cell from a larger lower cell.

All these abnormal modes of cleavage may, the author maintains, be explained upon his principle that the cleavage plane is at right angles to the axis of the nuclear spindle and that the position of the spindle-axis is dependant upon the shape and character of the protoplasm about it; the poles of the spindle lie in the directions of the greatest masses of protoplasm. Pressure acts by changing the shape of the protoplasmic mass and thus inducing a new direction for the nuclear spindles. That in the frog different forms of cleavage result when the egg is pressed from the side or from above downward is to be explained by the quality of the protoplasmic masses, the nature of the protoplasm, admixture of yolk, etc. being a factor as well as its mass in regulating the direction of the nuclear spindle. This explanation is thus more fundamental than the principles of surface tension and rectangular intersections of cleavage planes, which follow in part from this action of mass upon nuclear arrangement.

If the eggs remain under pressure between the plates or in the tubes they continue to develop, form gastrulas and, in some cases, larvæ. This furnishes a good means of confirming the contention of Pfluger and of Roux that the medullary folds really are formed upon that side of the egg which is at first the light colored lower side though they normally appear upon the upper side and would hence be naturally regarded as formed from the black or animal-pole side.

Between horizontal glass plates the gastrulation takes place so that the crescentic blastopore lip appears upon the edge of the lower side of the disk-shaped egg, at any point of this periphery. It then travels, in some way not observed, across the lower, flat surface, and closes at a point of the periphery diametrically opposite to that whence it started. Now in sections it is found that the yolk mass is at first at the end near the first position of the blastopore, then shifting, lies at the other end.

If the egg were free and not held fast by the pressing plates this shifting of the center of gravity would tend to revolve the egg so that its lighter colored part would become uppermost. Meanwhile the head fold and medullary folds come in near and along the region traversed by the blastopore (they are found upon the flat *under* side of the compressed egg) and hence would normally appear upon the upper side if this rolling of the egg took place.

Passing over some other interesting observations we may mention those made upon eggs that were forced to develop up-side-down. This was done by turning them over, under pressure, after the first or second cleavages. The light colored part of the egg thus remains uppermost The eggs develop normally at first but finally when gastrulation begins the blastopore is irregular in shape and the yolk is asymetrically distributed so that very imperfect and monstrous gastrulas result.

An attempt to separate the first two cells of tritons by drawing a loop of fine silk about the constriction between them did not succeed, since the two cells remained connected by an isthmus. Yet as they were held partly apart some curious modifications in the development resulted. The results are, however, very diverse. Each cell may cleave and a dumbell-shaped blastula result and eventually a monstrous embryo formed half upon one side of the thread, half upon the other or chiefly upon one side and partly upon the other. The nervous system may be outlined altogether upon one of the parts kept apart by the thread.

What may be considered the most important part of the paper is that treating of Hertwig's repetition of Roux's experiments upon the development of frogs eggs in which one of the first two cells is destroyed or injured by needle thrusts.

Such eggs continue to develop, but produce abnormal embryos. Roux maintained that the uninjured half of the egg formed a half blastula, half-gastrula, etc. Hertwig claims that this is not the case and figures many sections that support his claim very convincingly.

The development of the uninjured half of the egg is not as it would be in an entire egg but is so modified by the presence of a partly dead mass adjacent to it that it produces what may be called rather an abnormal blastula with an inclusion of inactive or dead yolk than in any sense a half-blastula.

Later, abnormal gastrulas are formed. These, however, are not *Semigastrulæ laterales*, *anteriores* or *posteriores* as Roux describes, but gastrulæ checked and distorted in their formation.

It seems, moreover, that only the presence of the inactive or dead yolk of the injured cell prevents the living cell from developing into a complete small gastrula as in the echinoderm experiments of Driesch. This dead or injured mass remains intimately attached to the live cell and hence is incorporated as a part of the embryo which it modifies somewhat as the yolk of a meroblastic egg modifies the part that forms the embryo.

Some eggs develop even the medullary folds and the notochord and form parts of larvæ. These are, however, very incomplete and also much varied in character; since, apparently, the injured cell is killed, coagulated, only in the part near the needle hole and may become, elsewhere, utilized as part of the embryo, this embryo will be more or less perfect according as the needle thrust has destroyed more or less and even according as it has destroyed one part or another of the cell, for thus the dead part will come to occupy a ventral or a dorsal position, etc., in the embryo.

This description of the formation of embryos that are more or less complete, according as the mass of inert substance is less or greater, is strongly opposed to the conception of Roux that, namely, the half egg first formed a half embryo. Yet Roux allowed that a more complete embryo was *subsequently* formed from the half by a process of revivification of the inert half, by what he called postgeneration. The ultimate result is thus the same according to either investigator.

Moreover Hertwig concedes that some process of "postgeneration" takes place to convert part of the inert mass into active cells; the injury to the cell having been in part but temporary so that it may later take part in forming the embryo.

While Roux insists upon the power of one cell to develop by itself as a half embryo and then to coerce the inactive half into the subsequent formation of the complete embryo, Hertwig lays stress upon the continuity and uniformity of a process that is from the first a formation of a whole embryo by the half-egg, subsequently, in part, assisted by the slow acting injured half.

With an omission of a critique upon Roux's conceptions of developmental processes we pass to the general conclusions that end the paper

Pressure that changes the shape of the amphibian egg induces great changes in the directions and sequence of the cleavage planes and in the size of the cells.

The direction of the planes results from the form of the cell and the distribution of its protoplasm.

There is no causal connection between the first planes and the axes of the body; the main axis of the body is not determined by the position of the first or second cleavage planes.

In the various induced forms of cleavage the nuclei that are formed become, in the different cases, distributed to very various parts of the yolk; they may be vicariously distributed to all parts of the yolk.

As the cleavage does not separate parts of the yolk predestined to form definite parts of the animal, so also the nuclei are not qualitatively divided into different kinds of nuclear material for the various cells. Yet normal embryos with normally placed organs arise from such mixed up or unnaturally distributed nuclei.

The egg contains no definite substance set apart to form special organs (liver-, skin-, retina-forming material) but it is isotropic. The contents of the egg ceases to be isotropic and becomes more and more specialized and organized in the process of cell multiplication with its important chemico-physical transformations (such as increase in the nuclear material).

In spite of this isotropy the egg is a definitely organized cell with yolk, protoplasm, etc., of different specific gravity.

This specific nature of the egg contents and also the shape of the egg exercises a directive influence over the process of development; the embryo at first must be adapted to the form of the egg.

The shape and position of the egg determine the position of the first cleavage planes.

As no rearrangement of heavy and light portions takes place in cleavage the distribution of mass in the egg corresponds to that in the blastula.

When the walls of the blastula are not uniform the gastrulation can take place only in a special zone which is below the equator when there is less yolk, as in the amphibian egg, and above when there is very much yolk, as in meroblastic eggs.

From an oval or elongated egg there is formed an elongated blastula, gastrula, etc. (in triton and insects, etc.).

As many eggs have elso a bilateral arrangement of their component substances there must follow a bilateral blastula in which the place for formation of the blastopore will be more sharply defined.

The chief axes of the embryo may correspond approximately to the first cleavage planes in eggs that are bilaterally symmetrical or that have one long diameter, since the character of the egg determines both.

In the gastrulation of the amphibian egg there is a revolution about an axis cutting the plane of symmetry and the plane of equilibrium.

Eggs of complex consistency are acted upon by gravitation so that they are oriented and if bilaterally symmetrical stand with the plane of symmetry vertical since this is also the plane of equilibrium.

If such eggs are forced to develop in a constrained position they form asymmetrical embryos so that gravitation is, in a sense, one of the influences determining structure.

If one of the first two cells of the egg is destroyed the other develops into a tolerably normal embryo having, however, some of its less important regions defective.

When one cell is but partly destroyed it may later form cells that are added to the uninjured half to help form the embryo. This secondary formation of cells in the injured half may be from the uninjured nucleus of that cell, or sometimes, by the migration of nuclei from the uninjured egg-half into the injured egg-half.

The development of the uninjured half, by itself or with the aid of part of the injured half, follows the same laws as the natural ontogeny of the species.

The injured yolk acts in the development of this half of the egg as the nutrient material does toward the formaitive in a meroblastic egg.

The process of postgeneration described by Roux does not take place nor is there a revivification of the destroyed egg-half.

Embryos with cleft blastopore cannot form double monsters by the process of postgeneration that Roux brought in to explain such a formation.

We cannot form at will half-anterior, -posterior or -lateral blastulas or embryos by destroying one of the first two cleavages cells.

In these cases of injury complex processes of adjustment may result in the formation of a normal embryo under changed circumstances.

The results obtained by these pressure experiments as well as the injury to one of the cleavage cells demonstrate the untenability of the mosaic theory, the theory of specialized germ areas and Weismann's theory of germ plasm.

The egg is a specifically organized one-celled organism that develops epigenetically by process of multiplication of cells with subsequent differentiation.

Since each cell comes from the first (the egg) by division it likewise contains the beginnings of the whole and becomes differentiated and specific during process of development according to the position it occupies in the whole at any period (gastrula, etc.). The reasons leading up to this position may be put under the following seven heads: 1. A complete organism may be formed from one of the first two or four cells; accordingly in different cases cells of like origin must be put to forming different organs. 2. As the gastrula mouth may appear at various parts of the periphery the cells concerned must have different ates in different cases. 3. The same is true in the abnormal cases of formation of multiple gastrula mouths; then there may be formed four instead of two eyes, ears, etc. 4. Frog's eggs that develop when held up-side-down must have the material utilized in a different way from the normal. 5. Thus also the triton larvæ show various ways of using the similar cells when the first two are partly separated by a thread. 6. When the frog develops up-side-down cases occur in which the lip of the blastopore is rolled outward and unites with the other lip so that the line of union is not between the edges of the lips but between the edge of one and the turning out surface of the other. Then the notochord and the medullary plate would be formed from cells quite other than those normally acting. 7. Changes in the cleavage process that so mix up the nuclear substance that it is assigned to different parts of the yolk in different eggs have no influence upon the normal result of development.

Thus in place of the mosaic theory of Roux and the germ-plasm theory of Weismann we may substitute the theory of the controlling inter-adjustments of the embryonic cells and later of the tissues and organs.

ENTOMOLOGY.[1]

The Four-lined Leaf-bug.—Another satisfactory monograph of a hitherto little-known injurious insect comes from the Cornell University Agricultural Experiment Station.[2] Mr. Slingerland reports that *Pœcilocapsus lineatus* has been destructive to currant foliage in New York for several years, sometimes rivalling, in damage done, the common currant-worm. Bushes on the university grounds "looked as though a fire had swept over them, leaving the prominent topmost leaves brown and dead." Such injury checks the growth of the bushes and materially lessens their productive capacity the following season. The past history of the insect is reviewed at some length, the discussion showing that it has been recognized as a destructive species for many years.

The four-lined leaf-bug shows an extraordinary range of food-plants, 54 species being listed as attacked by it. "Botanically considered, these lists are of interest, as they show an exceedingly wide range of food-plants for a single species of insect. Rarely do we find an insect attacking indiscriminately so many different plants with such widely different characteristics. The fifty-four species of plants represent forty-nine genera in thirty-one different families of the Flowering Plants. The Gymnosperms, like the pine, etc., are not represented, and but one genus (*Hemerocallis*) of the Monocotyledons. Fourteen of the plants are useful for food or medicine; twenty-nine are ornamental; while but eleven are wild species. Thus the beneficial results from the attack, rarely severe, of the insect upon the weeds, so termed, is slight compared with its frequently very injurious attacks upon the cultivated plants."

"The insect usually makes its first appearance in New York about the middle of May on the newest, tenderest terminal leaves. The insects are then so small and active in hiding themselves that they are not apt to attract attention. Their work, however, soon becomes apparent. Minute semi-transparent darkish spots appear on the terminal leaves. These spots are scarcely larger than a commonpin's head, and are round or slightly angular in shape, depending upon the direction of the minute veinlets of the leaf which bound them. The insect has inserted its beak into the leaf and sucked out nearly all of the opaque green pulp or parenchyma of the interior within a small area bounded by the little veinlets." These spots later turn brown

---

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Bull. 58. The Four-lined Leaf-bug. By Mark Vernon Slingerland. October, 1893.

and die; and, eventually, as the insects increase in size and destructive power, the leaves become withered and dead, as represented in Fig. 2 of the accompanying plate. "When all the tenderest leaves have succumbed, the insect continues its attack on the older leaves lower down. During its lifetime a single insect will destroy at least two or three currant or gooseberry leaves. This accounts for the fact that the injury wrought often seems much out of proportion to the number of insects at work.

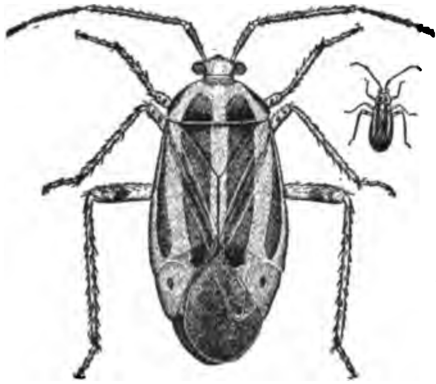


FIG. 1.—The adult insect; its natural size represented in small figure at the right.

"When the insects are very numerous, the growth of the shoots is often checked, they droop, wither, and die. Some have thought that this blasting of the growth was caused by a poisonous saliva which the insect injected into the wound made by its beak. However, it is more probable that the shoot dies or its growth is checked on account of the death of its breathing organs—the leaves. On the currant, gooseberry, and many other plants the insect confines its attacks to the leaves, but on some ornamental plants, as the dahlia and rose, the most frequent point of attack seems to be the buds."

Mr. Slingerland has, for the first time, traced the annual cycle of this pest. He finds that "the nymphs appear in the latter part of May upon shrubby plants where they continue to feed upon the tender leaves for two or three weeks, undergoing five moults. The adults appear early in June and often spread to different surrounding succulent plants. Egg-laying begins in the latter part of June; the eggs being laid in slits cut in the stems of shrubs near the tips of the new growth. The adults disappear in July and the insect hibernates in the egg. Only one brood occurs each year in our State."

The eggs are deposited in the stems, several being placed side by side in a longitudinal row (Fig. 2). The egg clusters as they appear on the surface of the young shoots are represen-

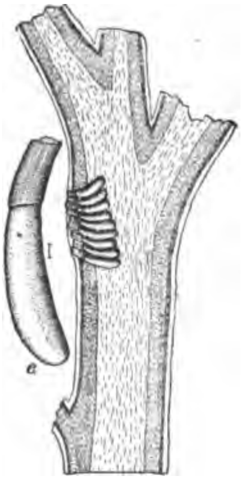


FIG. 2.—Section of currant stem showing eggs in position; *e*, egg, greatly enlarged.

ted in the upper figure of the accompanying plate. After much experimenting, Mr. Slingerland finds that "there are three practicable methods by which this pest can be controlled: kerosene emulsion for the nymphs; destruction of the eggs by pruning; and the capture of the nymphs and adults by jarring into receptacles where they are destroyed. Circumstances will largely determine which method will prove the most practicable in specific cases."

The bulletin concludes with an extended bibliography and synonymy, and is represented by 13 figures, four of which are reproduced herewith.

Indiana Orthoptera.—Two important papers, by Mr. W. S. Blatchley of the Terre Haute High School, have recently appeared.[3] The first is entitled the Locustidæ of Indiana, thirty-nine species being catalogued, while a list of twelve others that are likely to be found in the State is given.

Concerning the musical powers and general habits of these katydids and their allies, Mr. Blatchley writes: "The stridulating or musical organ of the males is quite similar to that of the male cricket, being found at the base of the overlapping dorsal surface of the tegmina, and usually consisting of a transparent membrane of a more or less rounded form, which is crossed by a prominent curved vein, which, on the under side, bears a single row of minute file-like teeth. In stridulating the wing covers are moved apart and then shuffled together again when these teeth are rubbed over a vein on the upper surface of the other wing cover, producing the familiar so-called 'katydid' sound. Each of the different species makes a distinct call or note of its own, and many of them have two calls, one of which they use by night and the other by day. Anyone who will pay close attention to these different calls, can soon learn to distinguish each species by its note as readily as the ornithologist can recognize different species of birds in the same

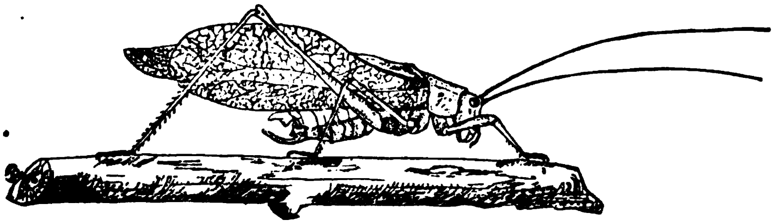


Fig. 3. A Locustid. [after Bruner].

---

[3] Proceedings Indiana Acad. Science, 1892, pp. 92–165.

manner. The ear of these insects, when present, is also similar in structure and position to that of the crickets, being an oblong or oval cavity covered with a transparent or whitish membrane, and situated near the basal end of the front tibiæ.

"The young of the Locustidæ, like those of the other families of the order, when hatched from the egg, resemble the adult in form, but are wholly wingless. As they increase in size they molt or shed their skin five times, the wings each time becoming more apparent, until after the fifth molt when they appear fully developed, and the insect is mature or full-grown, never increasing in size thereafter. Throughout their entire lives they are active, greedy feeders, mostly herbivorous in habit; and where present in numbers, necessarily do much damage to vegetation."

Mr. Blatchley's other paper is entitled "The Blattidæ of Indiana." Seven species belonging to five genera of cockroaches are catalogued.

"From the other Orthoptera the Blattidæ differ widely in the manner of oviposition, as the eggs are not laid one at a time, but all at once in a peculiar capsule or egg case called an oötheca. These capsules vary in the different species as regards the size, shape and the number of eggs they contain, but they are all similar in structure. Each one is divided lengthwise by a membranous partition into two cells. Within each of these cells is a single row of cylindrical pouches, somewhat similar in appearance to those of a cartridge belt, and within each pouch is an egg. The female cockroach often runs about for several days with an oötheca protruding from the abdomen, but finally drops it in a suitable place, and from it the young in time emerge." An introduced tropical species, *Panchlora viridis*, is viviparous.

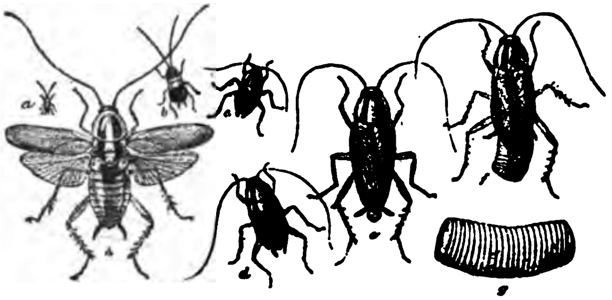


FIG. 4.—Croton Bug: *a*, first stage; *b*, second stage; *c*, third stage; *d*, fourth stage; *e*, adult; *f*, adult female with egg-case; *g*, egg-case —enlarged; *h*, adult with wings spread—all natural size except *g*.

"All young cockroaches resemble the parents in form, but are wholly wingless, the wings not appearing until after the fifth or last molt. The young are often mistaken for mature individuals." The stages of the common "Croton Bug," as represented by Dr. Riley, are shown in Fig. 4.

A Curious Hemipteron.—About the middle of January I received a curious looking specimen of Hemiptera which was taken in an agricultural implement warehouse. Owing to the extremely warm weather, the creature was quite active, and at first glance resembled an animated bit of rusty metal upon legs.

It proved to be of the family Reduviidae, recognized according to Latrielle by the elongated head which is free from the thorax, prominent eyes and two ocelli, antennæ of moderate length, filiform toward the ends and stout incurved beak. The tarsi are three-jointed, and the legs long and fitted for running.

This insect could probably be classified with *Reduvius personatus*, although of a reddish-brown rather than black, as members of this genus are said to have a habit of enveloping themselves in a thick coating of dust. This particular specimen was entirely covered with iron-dust and rust, possibly the only material at hand, and even the first joints of the antennæ and the densly hirsute limbs were thickly encased. The fourth hair-like antennal joints and the tarsi were clear of dust. Under the microscope numerous sharp, shining particles of steel and iron filings were to be seen, and the back, wingless and very concave, was heavily weighted. The insect moved rapidly, but with a peculiar creeping and halting gait, and proved to be very hard to kill. I first experimented with sulphur smoke, which had no perceptible effect. Then I placed the specimen in a prepared insect bottle, containing cyanide of potassium so strong that almost any soft bodied insect would become motionless instantly, and in this Reduvius lived several hours. Whether this was owing to the season of the year or to its unique coat of mail, I am unprepared to say.—LAURENE HIGHFIELD, *Quincy, Illinois.*

North American Membracidæ.—Dr. F. W. Goding has prepared a very useful catalogue of North American tree-hoppers.[4] Nearly three hundred species are included in the list, a considerable number of them being here described for the first time. Dr. Goding

---

[4] Bibliographical and Synonymical Catalogue of the Described Membracidæ of North America. By F. W. Goding, M. D., Ph.D. Bull. Ill. St. Lab. Nat. Hist., V. III, Art. XIV. Champaign, Ill., 1894.

has had access to ample collections and literature, and has filled nearly one hundred pages with the bibliography of this comparatively small family.

Colors of Lepidopterous Larvæ.—Prof. E. B. Poulton has an abstract of a memoir[5] entitled "The experimental proof that the colors of certain Lepidopterous Larvæ are largely due to the modified plant pigments derived from food." He divided into three lots one batch of eggs laid by *Tryphæna pronuba*, and fed them in darkness on green leaves, on yellow etiolated leaves and white midribs of cabbage. The last, whose food contained neither chlorophyll nor etiolin, were entirely unable to form the green or brown ground color.—*Journal Royal Microscopical Society.*

Effect of Arsenites on Caterpillars.—Professor C. H. Fernald reports[6] that in a series of experiments with various insecticides it was found that "gypsy caterpillars, when half-grown or larger, are not destroyed by any proportion of Paris green in water that can be used on fruit trees without injury to the foliage." A new insecticide—arsenate of lead—was tried with satisfactory results. "It did not injure even the most delicate foliage, however large a proportion was used. In one case, 24 pounds to 150 gallons of water were used without injury to the leaves."

Life-history of the Mole Cricket.—Some interesting details of the life-history of the European mole cricket (*Gryllotalpa vulgaris*) were recently communicated by M. F. Decaux to the *Societé Entomologique de France.*[7]

In some specimens under observation copulation took place April 15; the eggs were deposited by the end of April, and hatched May 15. At first the young are gregarious. All the young of a given brood do not mature at the same time; those maturing earliest reproduce 25 months after hatching, others 28 months, and a few even 35 months. These insects, M. Decaux says, are essentially carnivorous—feeding on insects, worms and slugs—but they accommodate themselves very well to a vegetable diet. He believes that the galleries are made not to pursue insects, but as places of defense and concealment.

News.—Prof. Charles Robertson has issued another instalment of his valuable papers on Flowers and Insects.

---

[5] Trans. Ent. Soc. London, 1893, pp. 255–265.

[6] Thirty-first Rep. Mass. Agr. College, p. 23.

[7] Bull. des Seances, No. 20, p. CCCXLI.

PLATE III.

FIG. 1.

FIG. 2.

Injuries of Four-lined Leaf-bug.

In his address as retiring president of the Cambridge Entomological Club, Mr. Wm. H. Ashmead discussed "The Habits of the Aculeate Hymenoptera." The address is being printed in *Psyche,* and is a paper of unusual biological interest.

Mr. F. J. Buckell discusses, at some length,[8] the proper name for the butterfly, variously known as *Danais archippus* or *Anosia plexippus,* and concludes that the insect should be called *Anosia archippus.*

Mrs. A. T. Slosson publishes[9] an interesting list of insects taken in the alpine region of Mt. Washington.

Mr. Howard Evarts Weed issues, as Bulletin 27 of the Mississippi Experiment Station a valuable discussion of insecticides, and their application.

In Bulletin No. 23 of the Maryland Experiment Station, Dr. C. V. Riley treats of some Injurious Insects of Maryland.

Mr. H. F. Wickham records[10] some interesting observations on the habits of oceanic Hemiptera. His observations indicate that Halobates may be drowned by submergence; and open up again the question as where these insects remain during stormy weather.

In his annual report on the gypsy moth, Prof. C. H. Fernald says: "In 1891, some experiments were made to determine what could be done toward entrapping the male moths by exposing females. In the spring of 1893, Prof. Shaler recommended that the monitor trap be tried on a large scale. This was done by enclosing the females in boxes covered on two sides by fine wire netting, and attaching to such boxes two sheets of paper covered with a resinous coating to which the male moths adhered. Fifteen traps were exposed in Malden, and 1,771 male moths were caught. The fact that so many moths were destroyed at a small expense, seems proof that trapping will prove an effectual and inexpensive method of preventing the increase in the numbers of the moth, especially as the males now seem to be comparatively scarce."

---

[8] Ent. Record, V. 1.

[9] Ent. News, V. 1.

[10] Ent. News. V. 33.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Indiana Academy of Sciences.—The Indiana Academy of Science held its ninth annual meeting in the rooms of the State Board of Agriculture, at the Capitol, Indianapolis, Dec. 27 and 28th, 1893, as stated in our last issue.

The following officers were elected for 1894.

President, Prof. W. A. Noyes, Rose Polytechnic Institute, Terre Haute; *Vice President*, A. W. Butler. Brookville; *Secretary*, Prof. C. A. Waldo, De Pauw University, Greencastle; *Ass't. Secretary*, Prof. W. W. Norman, De Pauw University, Greencastle; *Treasurer*, Prof. W. P. Shannon, Greensburg.

Boston Society of Natural History, January 3, 1894.—The following papers were read:—Mr. Leon S. Griswold, A brief description of the physical geography of Arkansas.

January 17.—The following papers were read: Mr. T. A. Jaggar, Experiments in the formation of ripple-marks. (Specimens were shown); Prof. N. S. Shaler, The topograpic evidence of ancient earthquakes.

SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington, January 27.—The following communications were read: Mr. J. N. Rose, A Botanical Trip to Northwestern Wyoming. Mr. B. T. Galloway, A consideration of the Anatomical and Physiological Processes involved in Leaf Fall; Dr. Theo. Gill, The Segregation of the Osteophysarial Fishes as fresh water forms; Dr. C. W. Stiles, An Interesting Cestode from India.

The Annual Address of the President of the Biological Society was delivered by Prof. C. V. Riley, in the lecture room of the Columbian University, at half past eight o'clock on Monday evening, January 29, 1894. The subject was Social Insects from the Psychological and Evolutional Points of View.

FREDERIC A. LUCAS, *Secretary.*

New York Academy of Sciences, Biological Section, January 29.—A paper was read by title, "A Case of reversed cleavage in a Sinistral Gasteropod," by Mr. H. C. Crampton, Jr.

Drawings were exhibited by Bashford Dean, showing original restorations of *Dipterus valenciennesii* S. & M., and of *Coelacanthus elegans* Newb.

Dr. J. L. Wortman exhibited an almost entire skeleton of *Patriofelis*, recently acquired by the American Museum of Natural History, and discussed its probable relationships. From structural characters of limbs he regards this creodont as nearest the ancestral form of the seals. Its spreading digits appear to have been webbed, and its coprolites show that its food material included turtles.

Dr. A. A. Julien read a paper on a newly discovered fungus from the petrified forest near Cairo, Egypt. Its genus is probably *Peronosporites*, and owing to remarkably perfect preservation its life history is to be determined.

BASHFORD DEAN, *Rec. Sec.*

SCIENTIFIC NEWS.

P. J. Van Beneden.—Professor Van Beneden, whose name is associated with the history of zoology, died recently, at the age of eighty-five years. One of his many contributions in aid of scientific work was the establishment, at his own expense, of a maritime laboratory at Ostend, which has since served as a model for others. His work extended throughout Zoology from the Protozoa to the Mammalia. At the time of his death he was one of the faculty of the University of Louvain.

Arthur Milnes Marshall, Professor of Biology in Owen's College, Manchester, England, who was as mentioned in our last issue killed recently by an accident, was both an investigator and a teacher of much ability, and was the author of many valuable biological papers, and of a text-book of Embryology. He is remembered in the United States, which he visited in 1884, for his activity ot both mind and body. His loss is greatly regretted. It is proposed now to erect a suitable memorial.

Paul Henri Fischer.—The Museum of Natural History of Paris has suffered a great loss in the person of Dr. Paul Henri Fischer, the well-known zoologist and paleontologist, who died on November 29, after a long and painful illness. Born at Paris, on July 7, 1835, he received his early classical and medical education at Bordeaux. He became *Tuterne des Hopitaux de Paris*, in 1859, and obtained his degree of Doctor of Medicine in 1863. The study of medicine did not prevent him from devoting himself also to that of the natural sciences;

for in 1861, he had entered as Demonstrator in the Laboratory of Paleontology of the Museum of Paris, under the direction of M. d'Archiac. His researches concerned above all the living and fossil Mollusca. Since 1886, he directed the *Journal de Conchyliologie*, in collaboration with M. Crosse. From the position of demonstrator he rose to be *aide-naturaliste* (assistant), and studied with great success the marine animals of the coast of France, their geographical and bathymetric distribution. He indicated the depths at which a large number of Foraminifera, Cœlenterata, Echinodermata, Mollusca, Bryozoa, etc., can be collected on the coasts of the west of France. In collaboration with the Marquis de Folen, he undertook the study of the animals dredged in the extremely interesting region of the Gulf of Gascogne to which the name "*Fosse du Cap Breton*" has been given. The two savants discovered a large number of form hitherto unknown, and many which recalled species only known in the fossil condition. With M. Delesse, he made researches on the submarine sediments of the French shores. He was elected member of the *Commission of Dredging*, and took part, from 1880 to 1883, on board the "*Travailleur*" and the "*Talisman*" in the celebrated expedition directed by Professor Milne-Edwards. In the course of these expeditions, he noted the enormous extension of a cold fauna characterised by boreal and Arctic species, and reaching as far as Senegal, where it lives beneath a superficial fauna with intertropical characters.

Among the writings of Fischer, which number not less than 300 titles, including books, pamphlets and memoirs, we may cite: *Paléontologie de l' Asie Mineure* (in collaboration with M. d'Archiac and M. deVerneuil); *Mollusques du Mexique et de l' Amérique centrale* (in collaboration with M. Crosse); *Species général et inconographie des coquilles vivantes; Animaux fossies du Mont Léberon* (in collaboration with M. Albert Gaudry and M. Tournouer); *Paléontologie de l'ile de Rhodes; Cétacés du Sud-ouest de la France*; *Catalogue et distribution géographique des Mollusques terrestres, fluviatiles et marins d' une partie de l' Indo-Chine; Sur les caractères de la faune conchyliologique terrestre et fluviatile récemment éteinte du Sahara; Sur la faune conchyliologique de l'ile d'Hainan (Chine)*; numerous memoirs on the malacological fauna of Lord Howe Island (Pacific Ocean); of Cambodia, of the Caledonian Archipelago Islands, of the Bay of Suez, etc. In collaboration with M. E. L. Bouvier, he published papers on the anatomical peculiarities of certain groups of Molluscs. Finally he wrote a remarkable treatise on Conchology, which has become classical. In this manual, the author shows that the classification of Mollusks ought to

be based not alone on the form of the shell, but primarily on anatomical characters.

Dr. Fischer was *Chevalier de la Légion d'Honneur* since 1871; *Officier de l'Instruction Publique* since 1881. He had obtained several prizes at the Académie des Sciences de Paris, and had been President of the Zoological and Geological Societies of France. He possessed deep erudition, was a charming talker, and after having treated a subject belonging to the domain of natural science or of medicine, he was far from embarrassed if he had to discuss philosophy, literature or esthetics. The death of this savant who was as affable as he was modest, has been a cause for general regret and for deep mourning among his large circle of friends.—EDMOND BORDAGE.

Dr. Samuel Lockwood, of Freehold, New Jersey, Died in January, 1894, at an advanced age. Dr. Lockwood was a frequent contributor to the scientific journals, and was well-known as an enthusiastic observer. His animal biographies will always be read with pleasure. They are scattered through various periodicals, but the NATURALIST probably published the majority. Such were the History of the Mocking-bird in New Jersey; the Singing Mouse; The Pine Snake; The Coati, etc. Dr. Lockwood was, for many years, a clergyman at Keyport, N. J., and subsequently became superintendent of the public schools of Monmouth Co., N. J. His interest in education was as great as it was in scientific research. He saved many valuable specimens for scientific study, among which was the type of *Plesiosaurus lockwoodii* of the Cretaceous beds, and the bones of the huge Dinosaur, *Ornithotarsus immanis.*

Mr. Samuel N. Rhoads, of Haddonfield, New Jersey, announces that he has discovered a perfect copy (2 vols.) of the long lost "Second American Edition" of Guthrie's Geography, published in 1815. This edition is the one which contains the part on American Zoology, by the celebrated naturalist, George Ord, where, for the first time, binomial scientific names are imposed upon several species of American Mammals and Birds. The article on Zoology is Mr. Ord's private annotated copy, and is intact within the second volume. A reprint of this copy is now being prepared for publication by Mr. Rhoads, to be ready for distribution in February. The reprint will be an exact reproduction of the original, and will include also comments on the marginal annotations, which, there is no doubt, were made by Mr. Ord himself.

The Botanical Club of the American Association for the Advancement of Science at a meeting held Aug. 19, 1892, adopted these principles of Nomenclature: *Resolved:* That the Paris code of 1867 be adopted except where it conflicts with the following: I. The Law of Priority. Priority of publication is to be regarded as the fundamental principle of botanical nomenclature. II. Beginning of Botanical Nomenclature. The botanical Nomenclature of both genera and species is to begin with the publication of the first edition of Linnæus "Species Plantarum," in 1753. III. Stability of Specific Names. In the transfer of a species to a genus other than the one under which it was first published the original specific name is to be retained, unless it is identical with the generic name or with a specific name previously used in that genus. IV. Homonyms. The publication of a generic name or a binominal invalidates the use of the same name for any subquently published genus or species respectively. V. Publication of Genera. Publication of a genus consists only (1) in the distribution of a printed description of the genus named. (2) in the publication of the name of the genus and the citation of one or more previously published species as examples or types of the genus, with or without a diagnosis. VI. Publication of Species. Publication of a species consists only (1) in the distribution of a printed description of the species named, (2) in the publishing of a binominal, with reference to a previously published species as a type. VII. Similar Generic Names. Similar generic names are not to be rejected on account of slight differences, except in the spelling of the same word; for example *Apios* and *Apium* are to be retained, but of *Epidendrum* and *Epidendron*, *Asetrocarpus* and *Astrocarpus*, the later is to be rejected VIII. Citation of Authorities. In the case of a species which has been transferred from one genus to another the original author must always be cited in parenthesis, followed by the author of the new binominal. N. L. Britton, John M. Coulter, Henry H. Rusby, William A. Kellerman, Frederick V. Coville, Lucien M. Underwood, Lester F. Ward, *Committee.*

At the meeting of the New York Academy of Sciences to be held on March 5th prox., will be held a debate between the supporters of the Neodarwinian and Neolamarckian theories of organic evolution. Prof. E. S. Poulton, of the University of Oxford, England, will open for the former, and Prof. E. D. Cope, of Philadelphia, will reply for the latter. Profs. W. B. Scott, of Princeton, and E. B. Wilson of New York, will also speak.

Prof. W. P. Wilson has brought to Philadelphia twenty-four car loads of exhibits, mostly of natural objects, which were displayed at the Chicago Exposition.

THE

AMERICAN NATURALIST

VOL. XXVIII. April, 1894. 328

WHENCE CAME THE CULTIVATED STRAWBERRY?

By L. H. Bailey.[1]

The strawberry has been extensively cultivated only during the last century, and the earliest attempt at methodical amelioration extends back little more than two hundred years. The first horticultural variety of which we have any account is the Fressant, which dates from 1660. The wild species of strawberries are few, not numbering more than a dozen under the most liberal estimate, and they are well represented in the great herbaria or botanical centers of the world. Only a part of the wild types have been impressed into cultivation, and exact or very approximates dates can be given for the introduction of these cultivated species.

The strawberry, therefore, is a modern fruit, and its history and evolution would seem to possess no difficulties; and yet, despite all these facts, the botanical origin of the cultivated varieties is unknown, and we have the anomaly of a common fruit, appearing within little more than a century, which the botanist does not refer to any species. Here, then, is a most remarkable instance of the evolution of a new type of plant, taking place under our very eyes: whilst the botanists have written precise histories of its successive progresses, the reasons and methods of its development have escaped them. Perhaps there is no other plant which has so quickly obscured its own

---

[1] Lecture before the Author's class in Horticulture, Cornell Univ., Ithaca, New York.

origin, or in which the speculative evolutionist can find stronger proof of the instability and elasticity of plants.

I have said that the history of the strawberry is well known. There has been a careful record from the time Casper Bauhin and his contemporaries wrote their voluminous herbals. We cannot expect, as this time, therefore, to add anything to this long and consequential record. We must accept the history essentially as we find it. But it is possible that we shall be able to elucidate the evolution of the strawberry by the application of some of the principles of plant variation, the knowledge of which is now sufficient to warrant a constructive retrospect. At all events, if these laws cannot solve the general problem of the evolution of the strawberry, we must continue to remain in ignorance of its birth and departure. This inquiry will be all the more interesting, also, from the fact that the first monographer of the strawberries, Duchesne, in 1766, made an attempt to explain the origin of known species from the Alpine or Everbearing strawberries of Europe, and this essay, which has apparently not attracted the attention of modern philosophers, is one of the earliest efforts to account for the origin of organisms by means of a course of development.

It is necessary at the outset to eliminate the so-called European types of strawberries from our inquiry. These belong to three or four species native to Europe, chiefly to *Fragaria vesca* and *F. moschata* (*F. elatior*), and the botanical characters are sufficiently clear and uniform to allow of little doubt as to their origin. The first strawberries, like the Fressant, are of this type. These European types are mostly small and delicate fruits which are grown in France and some other parts of continental Europe, but which are little more than curiosities in England and America. It is the class of large American and English strawberries to which I now wish to direct attention, a type which, while grown in all temperate countries, seems to have first come to great prominence in England and which is the only market strawberry of America.

The first foreign strawberry to reach Europe was the common small species of eastern America, and which is known to

botanists as *Fragaria Virginiana*. The first distinct record of it in Europe is in 1624, when it was mentioned by Jean and Vespasien Robin, gardeners to Louis XIII. For more than a century it appears not to have taken on any new or striking forms. It bore a small bright scarlet berry, with a distinct constriction or neck near the stem and slightly acid flesh. It was in no way very different, probably, from the common wild strawberry which we now pick in the fields. It was never greatly esteemed on the continent, but in England it found greater favor. Duchesne writes of it, in 1766, that "they still cultivate it in England with favor" (avec honneur). The original form of the Scarlet or Virginian strawberry was still highly esteemed in England less than three-quarters of a century ago, at which time Barnet[2] wrote enthusiastically of it. "This," [the Old Scarlet Strawberry] he says, "which has been an inhabitant of our gardens nearly, if not fully, two hundred years, was doubtless an original introduction from North America. It is singular that a kind of so much excellence, as to be at present scarcely surpassed by any of its class, should have been the first known. It continued in cultivation considerably more than half of the period of its existence as a garden fruit, without any variety having been produced of it, either by seed or by importation from America." Yet Barnet knew twenty-six good varieties of the species and describes them at length; and four of them seem to have come directly from America, probably from wild plants. A considerable progress had been made in the amelioration of the strawberry in England at the opening of the century, therefore, from the Virginian stock or foundation; but the varieties were much alike and contain little promise of the wonderful development in the strawberry varieties which we now enjoy.

About 1712, a second species of strawberry reached Europe. This is the *Fragaria Chiloensis*, brought from Chili to Marseilles by Capt. Frezier. It reached England in 1727. It is a stout, thick-leaved shaggy plant which bore a large globular or somewhat pointed late dark colored fruit. In a few places, particularly about Brest, in France, it came to be cultivated

---

[2] Trans. London Hort. Soc., vi, 152 (1824).

for its fruit; but in general it met small favor, particularly as the flowers were often imperfect and it did not fertilize itself. It did not seem to vary much under cultivation; at least, when Barnet wrote, about a century later, he knew only three varieties in England which he could refer to it, one of which he considered to be identical with the original plant as introduced by Frezier. The Chilian strawberry grows along the Pacific coast in both North and South America, and it has been introduced into our eastern gardens several times from wild sources; but it always soon disappears. There is little in the record of this species, therefore, of promise to the American horticulturist.

In the middle of the last century, a third strawberry appeared in Europe. Some writers place the date of its introduction with considerable exactness; but the fact is that no one knew just when or how it came. Phillip Miller described and figured it in 1760 as the Pine strawberry, in allusion to the pine-apple fragrance of its fruit. There were three opinions as to its origin at that time, some saying it came from Louisiana, others that it came from Virginia, while there was a report, originating in Holland, that it came from Surinam, which is now the coast of Dutch Guiana. None of these reports have been either confirmed or disproved, although Gay, in making extensive studies of the growth of strawberries, may be said to have effectually overturned the Surinam hypothesis in his remark that to find a strawberry growing at sea-level within five degrees of the equator, is like finding a palm in Iceland or Hammerfest![3] Duchesne, in his Natural History of Strawberries,[4] 1766, described a Pine-apple strawberry as *Fragaria ananassa*, and while he did not know its origin he argued that it must be a hybrid between the Chilian and Virginian species. The pine-apple strawberries of England and France were found to be different from each other upon comparison, although the differences were such as might arise within the limits of any species or type, and by the end of the century most botanists began to regard the two as

---

[3] Ann. Sci. Nat. 4th Ser. viii, 203 (1857).

[4] Histoire Naturelle des Fraisiers. Par M. Duchesne fils. Paris, 1766.

variations of one stock. This general type of Pine strawberries, comprising the large-hulled type long represented by the Bath Scarlet and erected into a distinct species by Duchesne as *Fragaria calyculata*, has been collectively known for a century as *Fragaria grandiflora*, a name bestowed by Ehrhart in 1792, although this name, together with the English name Pine, is gradually passing from use. We may say that thus far there are three hypotheses as to the origin of the Pine strawberry—that it came from North America, from Guiana, and that it is a compound or hybrid of two other species; and we may add a fourth—that apparently accepted by Duhamel and DeCandolle and certainly by Gay—that it is a direct modification of the Chilian strawberry, and also a fifth, advanced by Decaisne[5] and accepted by others, that some, at least, of the varieties are products of the large, robust native form of our wild strawberry which is known as *Fragaria Virginiana* var. *Illinoensis*. I shall drop the Guianian origin as wholly untenable, and it will also be unprofitable to discuss directly the question of importation from North America, for we have nothing more than conjecture upon which to found any historical argument. I shall now endeavor to discover which of the remaining three hypotheses is best supported in the subsequent evolution of the plant itself: Is it a hybrid, a direct development of the Chilian species, or a form of the native variety *Illinoensis?*

It is first necessary, however, to determine from what ancestral type our cultivated strawberry flora has sprung. Barnet, writing in 1824, referred all cultivated strawberries to seven groups or classes, three of which comprise the small European varieties which are outside this discussion. The remaining four classes comprise all the large-fruited types, and they are as follows: 1. The Scarlet or Virginian strawberries, with twenty-six varieties; 2. The Black strawberries or *Fragaria tincta* of Duchesne, with five varieties; 3. The Pines, with fifteen; 4. The True Chili strawberries, with three varieties. The Blacks and Pines are so nearly alike that they can be classed as one. Although the Pine class is the most recent of the lot, it had already varied into twenty forms, and, moreover,

---

[5] Jardin Fruitier du Museum, ix, under "Frasier d'Asa Gray."

it contained the choice of the varieties. In this class is Keen's Seedling, which was then coming into prominence. This variety is the first conspicuous and signal contribution to commercial strawberry culture, and it marks an epoch amongst strawberries similar to that made by the Isabella amongst American grapes. It was grown from seeds of Keen's Imperial, which, in turn was raised from the White Carolina (known also as Large White Chili), which is regarded by Barnet as a Pine strawberry. Thomas Andrew Knight had made various interesting and successful crosses amongst the Scarlet or Virginian strawberries, but Keen's varieties so far excelled them, that Knight's productions were soon lost. From Keen's Seedling the present English strawberries have largely descended. The fruit of this remarkable strawberry was first shown in London in 1821. At this time there were apparently no important varieties in this country of American origin. Prince,[6] writing in 1828, enumerates thirty strawberries of American gardens, of which all, or all but one, are of foreign origin. The two important varieties, and the ones which supplied "the principal bulk of this fruit sold in the New York market" were Red Chili (referred by Barnet and by George Lindley[7] to the Pines) and Early Hudson, probably a variety of *Fragaria Virginiana.* Keen's berries are in the list, but these, according to Hovey and other later writers, did not thrive in America. As late as 1837, Hovey wrote[8] that "as yet the plants of nearly all the kinds in cultivation have been introduced from the English gardens, and are not suited to the severity of our climate." Mr. Hovey resolved to produce an American strawberry, and with a shrewdness which has rarely been equalled in the breeding of plants, he selected parents representing distinct ideals and the best adaptations to American conditions. Four varieties entered into a certain batch of crosses which he made. These were Keen's Seedling and Mulberry, both Pines, Melon, probably a Pine, and Methven Scarlet, a variety of the Virginian. From these crosses, two

---

[6] A Short Treatise on Horticulture, 72. New York.

[7] A Guide to the Orchard and Kitchen Garden, 487. London, 1831.

[8] Mag. Hort. iii, 246.

varieties were obtained,[9] one of which fruited in 1836. These were the Hovey and Boston Pine. Owing to the loss of labels, it is not certain which crosses gave these varieties, but Mr. Hovey was always confident that the Hovey sprung from Mulberry crossed by Keen's Seedling. The Hovey strawberry revolutionized strawberry growing in this country. It was to America what Keen's Seedling was to England; and it marks the second epoch in commercial strawberry culture. American varieties now appeared from year to year, and the greater part of them have come directly or indirectly from the Hovey and the Boston Pine. With the passing out of the Boston Pine and its immediate offspring, the term Pine has practically been lost to American strawberry literature, and the word is but a memory in the minds of the older men; but this is not because the class itself has disappeared, but, on the contrary, because it has become the dominant class and has driven out the Scarlet and all other competitors. The Hovey was a true Pine strawberry. Mr. Hovey grew it in his garden till the last, and it was my good fortune to secure a few plants of him shortly before his death. A plant is now before me as I write, and it has all the marks of the old Pine or Grandiflora type—the thick rounded dark leaves, stocky habit, stiff flower cluster, and large spreading calyx. All our commercial strawberries are Pines, and they compare well in botanical characters with the *Fragaria grandiflora* of the French gardens of a half century ago and with the famous Bath Scarlet and Pitmaston Black which were important Pines when Barnet wrote, specimens of all of which I have before me.

Our strawberries, then, are lineal descendents of the old Pine class, known to botanists as *Fragaria ananassa* and *F. grandiflora*. Now the question recurs, what is the Pine? where did it come from? how did it originate? Three hypotheses, as I have said, have been advanced which an evolutionary review of the subject is capable of considering. Is it (1) a hybrid? (2) a direct development of the Chilian strawberry? or (3) a modified form of our big wild strawberry, *Fragaria Virginiana* var. *Illinoensis?*

---

[9] Mag. Hort. vi, 284 (1840). Fruits of America, i, 25, 27.

1. Is the Pine a hybrid? The only reason ever advanced for considering the Pine strawberry to be a hybrid was the supposed impossibility of accounting for its attributes upon any other hypothesis. The ideas of hybridity were indefinite in those times, and intermediateness of characters was often supposed to be enough—as it is, unfortunately, too often at the present day—to establish a hybrid origin. In considering this matter, two questions at once arise: (a) Does the Pine bear evidence of being a hybrid? (b) Would hybrid characters perpetuate themselves? I am wholly unable to find, either in herbarium specimens of the plants themselves or in the pictures of the plants, any distinct evidences of hybridity. The Pine strawberries differ from the Chilian chiefly in their greater size, less hairiness and better fruit, and sometimes by somewhat thinner leaves, although this thinness of foliage is usually more apparent than real, being due to the larger size and consequently greater flexibility of the leaf without any real diminution in substance; and I have seen as thin leaves in wild *Fragaria Chiloensis* as in garden berries. But greater size could scarcely be obtained from the smaller or or least more slender Virginian strawberry, and better sweet fruit would not likely result from the amalgamation of the Chilian with the little acid fruit of the other. On the other hand, there is not a character of the Virginian, so far as I know—save possibly some thinness of leaf—which appears in the Pine. The slender erect habit, smooth stems, profusion of early runners, comparatively simple and very weak-rayed trusses, the small calyx, the early, light-colored pitted fruit—none of these marks of the Virginian strawberry appear in the Pine. Again (b), it is now known that one of the most characteristic marks of hybrids is their variability when propagated from seeds; and yet Phillip Miller declares that the old Pine strawberry came true to seed! A hybrid left to itself almost invariably departs from its mongrel type and reverts to one or the other parent; and yet here is a supposed hybrid which has held its attributes intact for one hundred and fifty years, and has presented a sufficiently unbroken front to overcome all competi-

tors.[10] There is not only no evidence in favor of a hybrid origin, but there is very much against it; and I have no hesitation in discarding the hypothesis in favor of a simpler and more philosophical one.

2. Is the Pine strawberry a direct development of the Chili strawberry? Every feature of the Pine strawberry suggests the Chilian species. It differs chiefly in its greater size and sometimes by a slight loss of hairiness, but the relative sizes of the parts remain much the same as in the wild type. It is now well known that variation induced by changed conditions of life and augmented by subsequent selection, is the common and potent means of the evolution and amelioration of plants. Hybridization rarely effects a permanent evolution of types. To suppose that the Chilian strawberry should have varied into the type of the common strawberry is in accord with all the methods of nature. But there are two considerations which convince me beyond all question that cultivated strawberries belong to *Fragaria Chiloensis:* (a) Their botanical characters, which I shall discuss more fully in the next paragraph, (3), and (b) direct experiment. The experiment which I now record I consider to be of great importance. In 1890, I sent to Oregon for wild plants of *Fragaria Chiloensis.* The strawberries which I secured were short, stocky, thick-leaved, hairy, evergreen plants, at once distinguishable from the garden sorts. They were planted in a spot convenient for observation. I pressed one of the original plants and have taken specimens from time to time since. A specimen taken in May, 1891, is scarcely distinguishable from the wild plants set the year before, but specimens secured in July of the same year, show the longer stalkes and larger leaves of garden strawberries; while an average specimen taken in June, 1892, is indistinguishable from common cultivated varieties in botanical features! Here, then, is a change in two years, and not by seeds, either, but in the same original plants or their offshoots. This change, while remarkable, is still not unintelligible, for I have seen many cases of as great modification in plants

---

[10] For a general discussion of the theory of hybridity, consult Bailey, Cross-Breeding and Hybridizing, 1892.

under cultivation; and the Chilian strawberry is widely variable in its wild state. Barnet has inadvertently recorded a distinct departure from the type of the Chilian plant, for he says that while this strawberry usually loses its leaves in winter, the varieties which have been bred from it keep their leaves. This change in my plants is due primarily, no doubt, to a greater amount of food, arising from the greater space which the plants are allowed to occupy; and it is possible that other environments may have assisted in the transformation. Having this experimental evidence, which so forcibly supplements direct botanical evidence and so well emphasizes the known laws of plant variation, I can no longer doubt that the garden strawberries are *Fragaria Chiloensis*, that the early botanists did not recognize the garden type as a departure from this species, and that this type has finally driven from cultivation the forms of *Fragaria Virginiana*. And I am glad to know that so great an authority as the elder DeCandolle accepted the opinion of Seringe (1825) that the Pine, Bath Scarlet and Black strawberries belong to the Chilian species, for the Prodromus makes Duchesne's *Fragaria ananassa*, *F. calyculata* and *F. tincta* all varieties of the Chilian plant. This was evidently the opinion of the Dutch plantsmen of the middle of the last century, also, for even before Duchesne described the Pine strawberry, these merchants sold it under the name of *Fragaria Chiloensis ananæformis*, indicating that it was regarded as a form of the Chilian species. And Duhamel, towards the close of the last century, said that the Pine could be raised from seeds of the Chilian. It is evident, however, that Seringe did not mean to say that all the large garden strawberries are offshoots of the Chilian species, for he has a variety *hybrida* of *Fragaria Virginiana*, which is a supposed compound of this species and the Pine. But if there was any hybridization in the early days, I am confident that it was only incidental and its effect was transitory. Our present strawberries are apparently direct and legitimate progeny of the Chilian species.

3. Is the Pine strawberry derived from *Fragaria Virginiana* var. *Illinoensis?* I confess that I have believed until recently that the garden strawberries are offspring of our native berry;

certainly I have always hoped that such would prove to be their origin. It is with much reluctance that I give up a pleasant and patriotic hypothesis; but everything is against it. I had long thought that the Pine strawberry of last century was only this robust form of our native species, a feeling to which the early conjectures of an American origin for the Pine lent color. But the Pine and the var. *Illinoensis* are so unlike in habit that they could not have been confounded. When the var. *Illinoensis* was really introduced into Europe in 1852 by Asa Gray, who secured it from the "wild and savage" country in western New York, it was thought to be so distinct from all other strawberries that it was made a new species, *Fragaria Grayana,* although it is scarcely different, except in greater size, from the common *Fragaria Virginiana.* If this plant possessed such eminent and variable qualities as to have made it the parent of our garden varieties, it would certainly have given indications of them somewhere in its wide and varied range. As it is, it has only now and then come into cultivation, when its behavior has been such that it has soon been discarded, as in the well known instance of the recent Crystal City. I have also tried to cultivate it, and its response, like the Crystal City, is mostly in leaves and runners, not in any permanent or striking modification. It is true that the botanical features of the garden strawberries and the var. *Illinoensis* are much alike, particularly in herbarium specimens, and for some time I was not able to separate them readily; but there are botanical characters, even aside from habit, which distinguish them. The garden strawberries are lower in habit, producing runners freely only after fruiting, with shorter petioles and more leaves springing from the crown of the plant, and the leaves are spreading—all of which are striking peculiarities of the Chilian plant,—while in the native plant the leaves stand up on long nearly perpendicular stalks and the runners are produced at flowering time; the leaflets are thick and firm in texture, broader than in *Illinoensis* and lacking the long narrow base of the native, with mostly rounder teeth, and they are particularly distinguished by the dark upper surface and the bluish-white under surface of the mature leaflets, the

color of the leaflets in the native plant being light lively green, with little difference between the two surfaces. In these points of difference, too, the garden berries are characteristically like the Chilian. The truss or inflorescence is different in the two. In the garden berries, the truss stands more or less oblique or is often prostrate, and it is broken up into two or three strong, often unequal spreading arms from which the short and stout fruit-stems spring, and this is the distinctive habit of the Chilian species; in the *Illinoensis*, the truss is erect and it breaks up more regularly at its top and the inflorescence is less strongly spreading in proportion to the number of fruits it contains, and the fruit-stems are weak and slender and more or less drooping. The calyx is very large in the garden berries, a fact which Duchesne recorded in the name *Fragaria calyculata* which he applied to the large-hulled forms like the old Bath Scarlet, of which many are in cultivation at the present time. The fruit in *Illinoensis* is small and soft and bright scarlet, usually with a distinct neck and deeply embedded seeds; that of the garden berries still maintains the features of the Chilian berry in its large size, mostly globular-pointed form, dark color and seeds borne more nearly upon the surface. The garden berries are in every way much farther removed from the native berry than they are from the Chilian. From the latter they differ most widely, as I have said, in the taller growth and less hairiness;[11] but even in these features they do not resemble very closely the *Illinoensis*. It may be urged that all these differences might have come about under the influence of cultivation if *Illinoensis* itself had been the parent of the garden forms, to which I reply that direct experiment does not sustain the assumption, and that the excellent engravings of the early forms of the Pine strawberry show the same differences. It was the study of these pictures which first led me seriously to doubt the East-American origin

[11] It is often said that the fruit of the Chilian strawberry is erect and that the garden berries differ in a nodding fruit, but this is an error. While the fruit stems of the true Chilian are stiff, I have never known them to be erect, and in wild plants which I have grown, the fruit has the same drooping habit as in the garden berries. The Chilian species probably varies naturally in its fruiting habit, but I have yet to find an instance in which it holds its fruit upright.

of our strawberries. No one can examine the excellent colored pictures of Keen's berries,[12] and other early varieties, without being struck by the thick blue-bottomed leaves and wide-spreading arm-like trusses—indisputable marks of *Fragaria Chiloensis.*

Yet, despite these important botanical differences, the garden berries and the native *Illinoensis* are much alike, as I have said; and this similarity is really one of the arguments in support of a different geographical origin of the two. Similar climates or environments produce similar results, and when old berry fields are allowed to run wild, the plants do not revert to the type of the Chilian species, but are modified rather more in the direction of the indigenous plant. In the fall, when the flower trusses are gone and growth has ceased, it is sometimes almost impossible to distinguish between the leaves of spontaneous garden berries and wild *Illinoensis;* but the flower clusters the following spring will be likely to distinguish the two. As a matter of fact, garden berries probably do not often persist long when run wild. They are unable to contend with the grass and weeds, although *Illinoensis* may find in similar circumstances an acceptable foothold. It is not strange, therefore, that those individuals from the old cultivated beds which longest persist should be those nearest like the native berries, for such would fit most perfectly into the feral conditions.

There is only one conclusion, therefore, which fully satsifies all the demands of history, philosophy, and botanical evidence, and this is that the garden strawberries are a direct modification of the Chili strawberry. The initial variation occurred when species were thought to be more or less immutable, and, lacking exact historical evidence of introduction from a foreign country, hybridization was the most natural explanation of the appearance of the strange type. This modified type has driven from cultivation the Virginian berries which were earlier introduced into gardens; and the original type of the Chilian strawberry is little known, as it tends to quickly dis-

---

[12] See, for instance, the plate of Keen's Seedling in Trans. London Hort. Soc., v 261.

appear through variation when impressed into cultivation. The strawberry is an instance of the evolution of a type of plant in less than fifty years, which is so distinct from all others that three species have been erected upon it, which was uniformly kept distinct from other species by the botanists who had occasion to know it best, and which appears to have been rarely specifically associated with the species from which it sprung.

THE PARASITIC PROTOZOA FOUND IN CANCEROUS DISEASES.

BY ALICE BODINGTON.

In the British Medical Journal for Feb. 26th, 1893, the "steady increase of cancer" is spoken of as a subject requiring serious attention, and as far back as 1887–8, the Council of the Association drew the attention of the Registrar-General to the "steady increase in the deaths from cancer," out of proportion to the deaths from all causes, and showed *that similar conditions exist in most civilized countries.* The "increasing mortality from this terrible disease, not merely kills nearly twenty thousand persons in England and Wales alone" [the southern part of one small island !] but kills the vast majority of them by slow and cruel torture continued during a long series of months, sometimes of years." Cancer, like insanity, seems specially to find in the highest conditions of civilization a hot bed in which it flourishes and spreads; and any clue which can guide civilized man to the secret of grappling successfully with this hitherto unconquerable foe, will be one of the greatest boons which science can confer upon mankind. To know where the enemy lurks, and in what form, is, in the case of parasitic diseases, not only half but sometimes all the battle; as the almost complete immunity from cholera of England has shown.

An army of keen observers has endeavoured for many years past to discover, if possible, the exciting cause of cancer, but till lately the prospect of discovering the foe appeared hopeless. The theory which seemed most firmly established, most consonant with scientific theory, was at the same time a singularly hopeless one. It was assumed that at the decline of life, or under conditions of lowered vitality in the whole or part of the body, certain embryonic structures—especially of the kind known as "survivals"—took on an abnormal growth, and rioted in the production of epithelial cells of a low type which

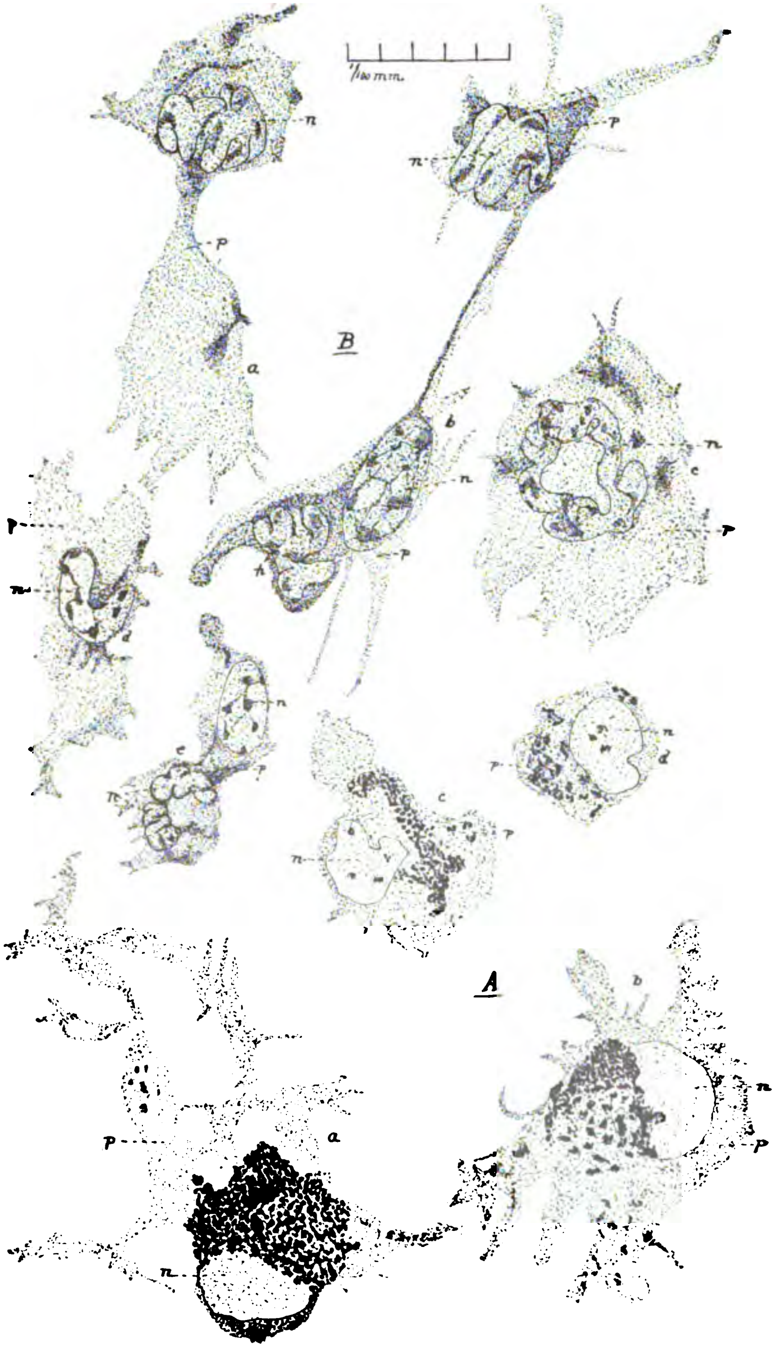
flourished at the expense of the healthy structures round them. Now any disease arising from degeneration or overgrowth of embryonic survivals, [such as the remains of the Wolffian duct in the female] sets at defiance all human precautions; the embryonic tissue is hidden, and no one can tell either when or why it begins to go wrong. If cancer owed its rise simply and solely to an overgrowth of embryonic tissue, there was no hope but in an early, a thorough, an unsparing use of the knife; no *stamping out* of the disease could be hoped for or thought of. All attempts to trace the disease to the action of bacteria failed. But during the last few months the patient, cautious, untiring labour of years of a number of distinguished pathologists has enabled them to detect the existence of organisms in cancer, which resemble, in all that is known as yet of their life history, the Sporozoa; and more especially the *Coccidium oviforme.* (Leuckart), of the rabbit.

Fig. 1.—*a*, Coccidium showing capsule full of granular protoplasm; *b* shows condensation of the protoplasm into one sphere, after two days' growth external to body; *c*, division of the single sphere into four daughter spherules, after four days' development; *d*, an empty ruptured cyst. (From photographs x about 500.)

The whole life cycle of *Coccidium oviforme* is now known; its discovery has been the work of more than thirty years, so that there is no reason for discouragement if some stages of the life history of the Coccidium found in cancer still elude research.

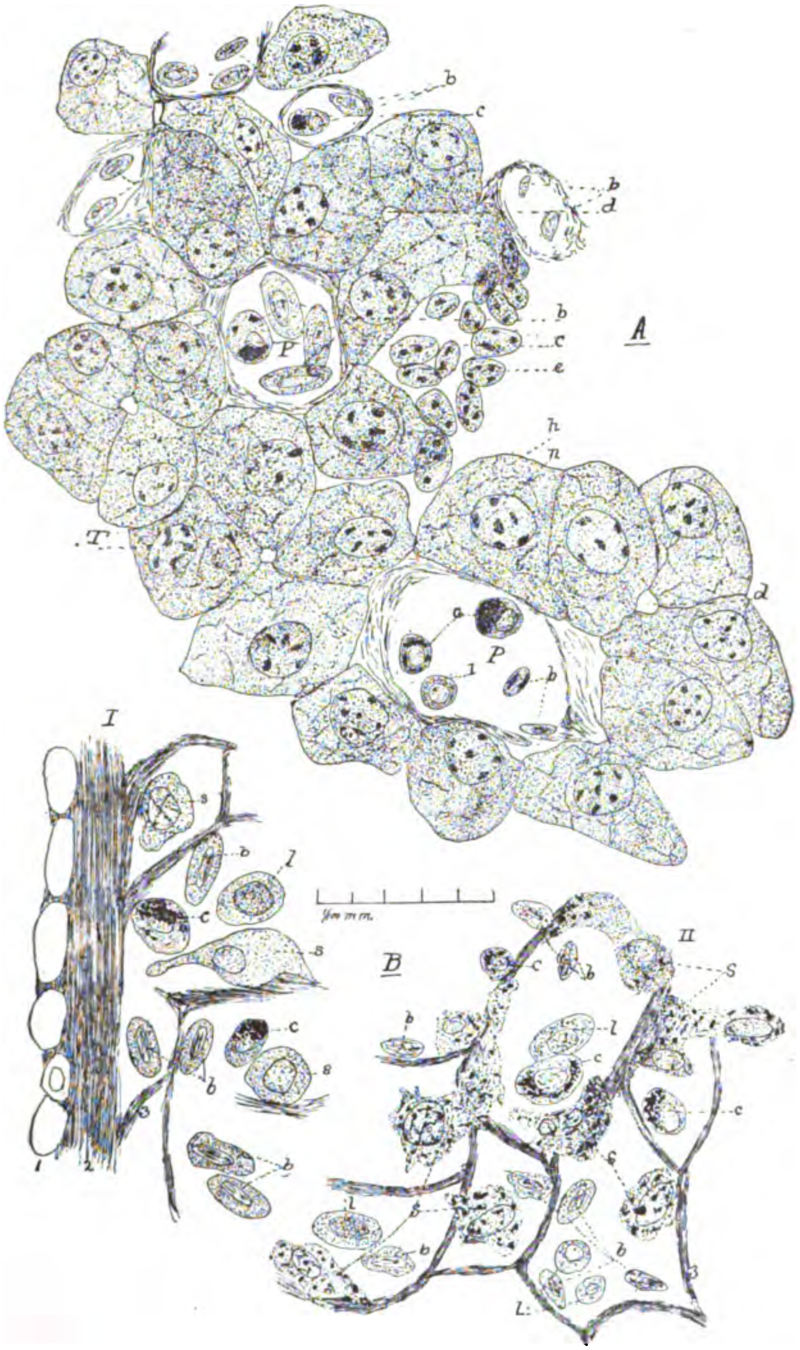
Dr. Galloway after describing the symptoms of coccidian infection in the rabbit, begins with the life of the protozöon after it leaves the body. "The organism" he says "as it escapes from the alimentary canal consists of a firm translu-

PLATE IV.



Leucocytes of Necturus and Cryptobranchus.

PLATE V.



Sections of Liver and Spleen of Cryptobranchus.

cent cyst oval in shape [see Fig. 1, *a*] enclosing a quantity of very granular protoplasm which fills the whole body. Very soon after expulsion, and often while within the host, the protoplasmic contents contract [Fig. 1, *b*] and form a sphere lying free within the cell wall. Under suitable circumstances, this ball of protoplasm sends out projections and at length divides into four distinct smaller spherules [Fig. 1, *c*.]" These four spherules are "transformed[1] into four spores provided with a very resistant external covering. Each spore encloses two falciform and very delicate embryos, [Fig. 2.] which give birth to new parasites, and thus engender the terrible disease when swallowed in polluted food. The sporiferous coccidia penetrate into the digestive canal of rabbits, and the envelope of the spore protects the falciform embryos against the action of the gastric juice. So strong is the protecting capsule that the spores can live for at least six months outside the body [Galloway]. The epithelial cells of the small intestine and of the biliary ducts are the seat of the internal activity of the parasite, on reaching which a "new cycle of intense activity is observed. The falciform young take on a rounded shape, and probably acquire the power of locomotion. Most of the naked amœboid forms of the organism divide into small crescentic

Fig. 2—Stages in Life History of *Coccidium oviforme*. *a, b.* Formation of crescentic spores within the daughter spherules external to the host (after Balbiani); *c, d,* sporulation within the host, division of the spores into numerous crescentic segments. (After photographs by Pfeiffer x 1,000.) From 'Morton Lectures,' by James Galloway, A. M.; M. D. Aberdeen. British Medical Journal. Feb. 4th, 1893.

---

[1] Carcinomata and Coccidia, Elias Metschnikoff, M. D. Chef de Service, Institut Pasteur. Revue Générale des Sciences Pures et Appliquées. Brit. Medical Journal. Dec. 10th, 1892.

sporules, which, in their turn, also become free, and myriads of young sporozoa are soon formed. These possess the "power of insinuating themselves into the protoplasm of epithelial cells, where they grow and become transformed into oval parasites resembling the adult form" [Metschnikoff]. In course of time, the epithelial cell wall is ruptured and the parasite escapes, without necessarily causing the destruction of the pest cell; it passes through the alimentary canal, gains access to the atmosphere, and thus attains the conditions necessary to recommencing its cycle of development. Having been shown the life history of the coccidian parasite of the rabbit,[2] we shall be better prepared to recognize the [apparently] kindred disease in man and some of the higher vertebrates. "Taking cancer of the breast as an example," says Dr. Galloway, "if careful microscopic examination is made, there will be found lying, most commonly within the cell body, rounded or oval structures varying in most cases from 2 μ to 10 μ in diameter, having, when large, a very distinct capsule, and containing a smaller body of variable shape. From the capsule there may be seen passing towards the centre numerous fine radial striations, ... and processes of a somewhat different character may also be seen passing from the nucleus towards the periphery; they are not so regular and appear to be prolongations of the nucleus.

"These bodies occur sometimes singly, sometimes in twos and threes, and occasionally to the number of nine or ten—and even twenty,[3] of small size—in a single cell. In a successful preparation each of the small ones will be seen to contain the usual nuclear substance (see Figs. 3 and 4). Similar structures of smaller size may be observed lying *inside the nucleus* of the epithelial cells. In this ease the capsule, so very characteristic of the intracellular bodies, is very slight, and indeed, appears to be absent in most cases. "The intra-nuclear bodies also occur either singly or in small groups." Occasionally the

---

[2] See also Fig. XVII, Sporozoa; *Gregarinidæ* article Protozoa, Encyclopedia Britannica, pp. 852-3.

[3] "I have seen over 20 parasites in the same nucleus."—M. Armand Ruffer, M. D., *B. Medical Journal*, Nov. 5, 1892.

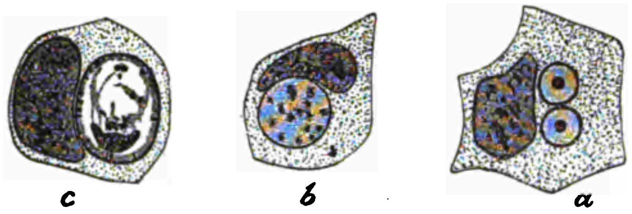


FIG. 3.

Cells from different cancers of the breast, showing various forms of parasites in the cell protoplasm × 1,200.

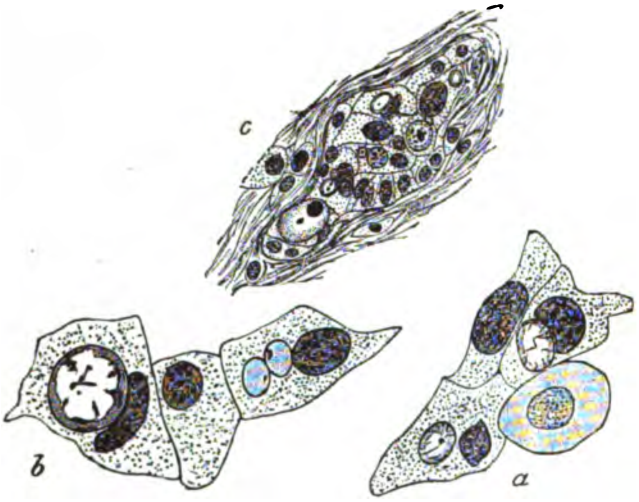


FIG. 4.

a and *b*, Groups of cells containing intracellular parasites × about 1,000; *c* cancer alveolus from edge of rapidly growing carcinoma of breast, showing numerous parasites × about 400.

bodies may be seen partly within and partly without the nucleus in the act of passing through the latter into the cell protoplasm. In certain cases the nucleus seems to become filled up with numerous small parasites which escape into the cell protoplasm after having burst through the nucleus.[4] The

---

[4] See "Preliminary Note on some Parasitic Protozoa found in Cancerous Diseases." By M. Armand Ruffer, M. D. and J. Herbert Walker, M. A. *B. Medical Journal,* July 16, 1892.

Also, "Recent Researches on Protozoa and Disease." By M. Armand Ruffer, M. D. *B. Medical Journal,* Oct. 14, 1893.

nucleus of the cancer cell when it bursts through over-distension with parasites, perishes, but when only one or two parasites escape, it usually heals up perfectly.

For the further life history of protozoa of cancer, we may follow Mr. Jackson Clarke.[5] In describing his examination of a myeloid sarcoma, he says: "In the most interesting portion of the neoplasm, its advancing border, the entire peripheral zone of the section could be examined from end to end without anything but amœboid psorosperms and remains of infiltrated connective tissues coming into view. In the centre of the field [Fig. 5] is a psorosperm in the plasmodium stage, in which spore-formation is commencing. Below is part of a giant cell containing one encapsuled and two amœboid psorosperms; numerous free amœboid parasites, and to the left is part of a large plasmodium, within which are nuclei and fibres undergoing digestion.

FIG. 5.

In this sarcoma, as in all the cancers, I have examined recently, there is, in the advancing zone, an army of amœboid psorosperms invading and digesting the tissues beyond, and *determining new growth in the special tissue with which the parasites have established a symbiosis.* For it appears that the curious inter-dependence of two organisms, known as symbiosis, has

---

[5] Sarcoma Caused by Psorosperms. By J. Jackson Clarke, M. B., F.R.C.S. *B. Medical Journal,* Dec. 24, 1892, and Jan. 21, 1893.

been established between the malignant parasite of cancer and certain epithelial and mesoblastic tissues. *These tissues are excited to enormous overgrowth by the presence of the parasites, whilst the tissues with which they have not established a symbiosis are invaded, devoured and destroyed.* Mr. Jackson Clarke thus describes the process: "The amœboid parasites make their way between the epithelial cells and pass in vast numbers into the connective tissue spaces beyond the epithelial part of the growth. In their passage they cause the rows of epithelial cells to separate, and thus bring about a multiplication of the points of epithelial ingrowth and detachments of small groups of epithelial cells. A considerable amount of inflammation is caused by the invasion of the vascular tissues by the amœbæ, with the same result as that seen in inflammatory papillomata; an extension of epithelial growth, and a formation of new blood-vessels. Most of the amœbæ disappear, but a small proportion enter epithelial cells, where, even in the non-nucleated stage, they could be detected," and the evil cycle is carried on.

Messrs Ruffer and Walker, the first pathologists who demonstrated the existence of the cancer parasite in England, state that they found a mixture of Foll's solution, with 1 per cent. of osmic acid, gave the most satisfactory results as a hardening reagent,[6] especially in demonstrating the intranuclear parasites. Biondi's mixture as a coloring agent brings out the organisms with all the clearness that can be desired. The "coccidia, stained a light blue, enclose a dark brown nucleus, the cancerous cell is stained a dirty yellow white, while its nucleus takes a green tint" [Metschnikoff].

Metschnikoff is of opinion than the coccidiosis of the rabbit is a miasmatic disease of the most typical kind, and that carcinomata also approximate to the category of miasmatic affections. "Although less pronounced than malaria or goitre," he observes, "the endemic character of cancer is a fact that has often struck observers. The frequency of these malignant tumors is far from being the same in all countries. By the side

---

[6] Second Note on Parasitic Protozoa in Cancerous Tumors. *B. Medical Journal*, Nov. 5, 1892.

of regions of the globe which are exempt, or very nearly so, from this disease [Faroë Islands] there are others where carcinomata are very common." According to Cohnheim's theory of a simple overgrowth of embryonic survival tissues, the average of victims to cancer should be the same in every part of the world, and liability to its ravages should be common to all the Metazoa. Metschnikoff points out another feature which cancers have in common with coccidian diseases—the exaggerated proliferation of the epithelial cells in the affected organs. How close the resemblance is, the following figures show.

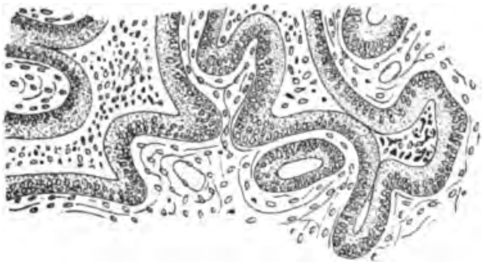


FIG. 6.

Adeno-Carcinoma of the Rectum in Man.

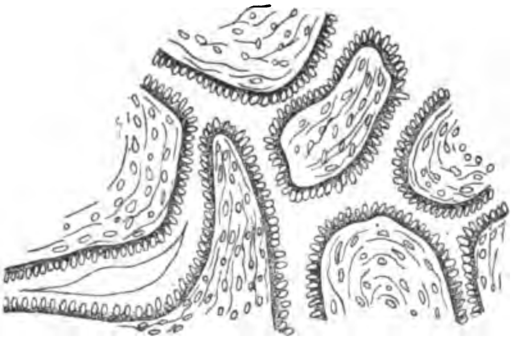


FIG. 7.

Hyperplasia of the biliary ducts of the rabbit under the influence of coccidia.

As yet, the study of parasitism in cancerous diseases is only beginning. The coccidia of the rabbit have been known for

half a century, but it is only quite recently that an important stage in their life-history has been made out. There are differences of opinion between observers; Mr. Jackson Clarke's amœba-like organisms do not exactly correspond with the various forms of parasites described by some other pathologists. It is thought possible that the whole life-cycle of the protozoön may be passed within its human host; in any case, its exogenous history is not known, and this stage is the one which it would be the most useful to discover, since we are, at present, in utter darkness as to the mode in which the contagion is conveyed to the host. Cancer is pronounced to be a disease in which heredity plays an important part. Does it do so in the same way that hereditary predisposition acts in tuberculous diseases; not by a direct transmission of the tubercle bacillus, but by some mysterious lowering of the vital powers of resistance? It is hardly possible to imagine that microsporidia, hereafter to develop into the protozon of cancer, can remain dormant for 50, 60, 70, 80 years.

The disease [so far as can be ascertained from experiments upon animals, themselves liable to cancer] is not directly transferable from one host to another. There remains, therefore, as a highly probable hypothesis that the exogenous form of the protozoön of cancer, like the flagellate monad of malaria and the coccidia of the rabbit, must be sought in contaminated soil or water. It is because this most important stage of the life history of the protozoön of cancer is unknown, that I have ventured to present a summary of some of the papers which have been appearing for some months in the *British Medical Journal* to the readers of the AMERICAN NATURALIST; hoping that workers skilled in researches among the Protozoa may take up the subject, and may come to the aid of the brilliant band of pathologists who have thrown so much light on a most difficult problem.

THE ACTION OF LEUCOCYTES TOWARD FOREIGN SUBSTANCES.[1]

EDITH J. CLAYPOLE, M. S.

Among the many problems that yet await solution at the hands of the physiologist and histologist, those relating to the disappearance of so many leucocytes or white blood corpuscles from the animal body have long afforded a fruitful field for work. Under what conditions and by what means they are destroyed is as yet but partly known, and different theories are advanced as to the most probable method of this destruction. The constant relation, normally, that exists between the numbers of the white and red cells of the blood, in spite of the steady supply of white cells that is poured into the blood from the lymphatics, establishes the fact that somewhere there is as steady a drain on the numbers.

The nature of leucocytes as entities in the economy of the animal body is of especial importance in consideration of the second point and a careful study of these cells in a living condition helps one to realize their activities and powers. The ability of these cells to take up foreign substances by virtue of their amoeboid movement is very significant to the physiologist especially from a pathological standpoint. The great Russian morphologist, Metschnikoff, has based his phagocyte doctrine on the peculiarity given to these cells by the exercise of this power, giving to them in consequence an additional and important duty. They form, as it were, a guardian army in the animal body, ever alert and watchful for the invading enemy. A constant warfare is being waged between these leucocytes and all foreign material, organic or inorganic, that enters the system. By the process of ingestion the immediate influence

---

[1] This paper contains part of the results of an investigation carried on in the Histological Laboratory of Cornell University during last year. I wish to express my appreciation of the abundant material and facilities which were so generously put at my disposal. The whole paper afterwards received the first prize offered by the American Microscopical Society for original work in animal Histology.

of the substances is removed from the tissues. The balance of power continually wavers between these two hosts, on the one hand the leucocytes and on the other the different kinds of organisms and matter, injurious or non-injurious, to which the animal body is hourly exposed. If the invaders are too strong the results become evident in the sickness or perhaps death of the animal. But if the leucocytes are victorious, and are able to clear the system of the foreign substances, normal conditions are again established and with them the health of the individual. By no means is it necessary, however, that the conflict become apparent externally. This at least is the story picturesquely put as the founder of the "Phagocyte Theory" reads it. It may be rather extreme; certainly there are those who consider the protective part played by the leucocytes to be quite small, relatively speaking or merely incidental. That they can and do ingest foreign particles and are subsequently to be found in the various tissues bearing their loads, is however, proved. It is only the interpretations laid on the facts that differ.

Many experiments have been made from a pathological standpoint to prove, if possible, the true part played by the various tissues and cells in diseases, which owe their existence to the presence of foreign matter or foreign organisms in the body. Naturally from the medical standpoint these experiments have been made on mammals of various kinds, the only other animal used being the ever useful frog. In contrast to this basis of work is the normal physiological condition existing under ordinary circumstances in animal life. All the experiments, of which the results are here given, were made under as purely normal conditions as possible, in every way anything that might produce abnormal results, being avoided. The animals used for these experiments were the two salamanders, *Necturus maculatus* or the Mud-puppy and *Cryptobranchus alleghaniensis*, the Hell-bender.

For several reasons these animals afford peculiar advantages for an investigation of this kind. Of great importance among these is the large size of the leucocytes and of the various tissue cells, and also the comparatively simple structure of

the different organs. Another great advantage in the study of the living leucocytes lies in their activity in the ordinary temperature of a room, a fact, which affords an opportunity for the close observation of the process of ingestion. By mixing on a slide a small drop of fresh blood or lymph with a small quantity of lamp-black suspended in normal salt solution, the taking up or ingestion of the carbon by the leucocytes can be seen to take place while they pass through their amoeboid phases. In a few hours the cells become filled with carbon particles (Pl. IV), which are, however, contained exclusively in the cell body although appearances suggest their presence in the nuclei. These latter parts also exhibit amoeboid forms (Pl. IV). By watching the cells carefully the granules are seen to move across the nuclei and gradually leave it clear, proving beyond doubt that they are in the cell body.

In introducing the carbon into the living animals the following method was used. Into the abdominal cavity of the animals from ¼–1 c. c. of a mixture of lamp black, gum arabic and normal salt solution was injected. Here it should be said that in these animals this cavity forms practically a great lymph space, in which the carbon is ingested by the leucocytes, the latter then pass into the blood circulation and from that to the various organs and tissues. After periods varying from 4–10 days different animals were killed and the blood and tissues examined. In the case of Necturus, owing to the presence of external gills, the time of the appearance of the carbon-laden cells in the blood could be easily determined. By etherizing the animals and microscopically examining the circulation of the blood in the gill filaments once or twice a day the time of the appearance and also of the disappearance of ingested cells can be noted. The earliest appearance was on the 6th and the latest on the 9th days after injection. After 16 days a few scattered cells still remained. The results now given were chiefly obtained from a specimen of Cryptobranchus killed 10 days after injection.

In the microscopical examination of the tissues the first difficulty encountered lay in the presence of a large amount of natural pigment in the tissues. This is confusing both from

the similarity in colour and from the necessary obscuring of structural parts. Caustic potash destroys melanin, but boiling is required and that of necessity injures the tissues. Ether, alcohol, acids and strong alkalies will also remove the colour, but the last two destroy the tissues and the first two decolorize so slowly as to be practically useless. By means of hydrogen dioxide the most successful results were obtained. The sections when cut and fastened to the slide were put in a vial of a 2% solution of the liquid. In from 6–48 hours, depending on the amount of pigment present, the color is reduced from black to a pale yellow without any attendant injury to the tissues. The process of decolourization is materially hastened by placing the vial containing the liquid and tissue in the strong sunlight and if desired all traces of the pigment can be removed. Practically it was found to be a great advantage to leave sufficient colour to mark the position of the pigment-bearing cells. By this method the black ingested leucocytes were easily distinguished wherever they occurred, and no chance for confusion remained.

Serial sections were made of the following parts: the spleen, kidney, ureters, liver, lung, stomach, muscle and skin. In all these parts ingested cells were present, but the positions and relations differed somewhat with the different organs. In the kidney (Pl. VI) carbon-laden leucocytes were in the blood capillaries, in the glomeruli, in the lymph spaces surrounding the capsules of the glomeruli, in the urinary tubules and in the nephrostomes. These latter parts are peculiar structures present in the amphibian kidney and are marks of a much more primitive form of that organ than exists in mammals. They consist of small ciliated funnels opening on the ventral surface of the kidney directly into the abdominal cavity. A small tube then unites these funnels with the urinary tubule arising from the glomeruli. The ingested leucocytes were in these funnels and by a series of sections they could be found to pass down the tube and into the urinary tubule. No doubt the number of leucocytes that pass from the blood circulation into the tubules is largely increased by additions from this source. No signs of ingested leucocytes in other than these

places were found, or any trace of free carbon. Serial sections made of the ureters (Pl. VI) close to their openings into the cloaca showed masses of ingested cells. This indicated that a considerable number of such cells found their way out of the body in this way. Uningested cells were also found among those containing carbon. In the liver (Pl. V) ingested cells were found in the blood vessels alone. No extra-vascular carbon-laden leucocytes were present. In the stomach (Pl. VII) the carbon-laden cells were in the blood-vessels, in the epithelial tissue of the stomach and free on the inner surface, showing a gradual passage from the vessels to the epithelial surfaces. In the lungs (Pl. VI) practically the same time condition existed and also in the skin (Pl. VII). In the latter leucocytes could be traced from the blood-capillaries through the various layers and finally free on the outer surface of the skin. That these outside had not come from accidental external contact was proved by the fact that no red corpuscles were among these leucocytes and with the very rapid coagulation that takes place in amphibian blood it would be impossible for the white cells to be completely isolated from the red. In various parts of the muscular tissue, either in the lymphatics or simply between the muscular fibres, ingested cells occurred rarely.

In all these parts there was absolutely no evidence for the presence of free carbon or carbon in any other cells than leucocytes. When, however, the spleen (Pl. V) was examined some peculiar and very interesting differences were found. The carbon was contained in leucocytes of a similar nature to those in previous cases, but in addition round the malpighian corpuscles there was what seemed at first sight to be a free deposit of carbon. But when carefully observed the carbon proved to be contained in cells that from their position were judged to be spleen-pulp cells. The distribution of the carbon in these cells differed exceedingly from that present in the leucocytes. Instead of being massed irregularly the carbon was evenly scattered through the cells, and, owing to the extended condition of the latter, covered a large area. When the fact of the presenee of carbon in these cells was established the question of the means of the transfer of the carbon from

the leucocytes to the spleen cells at once arose. It was already proved that no free carbon entered the blood circulation. Consequently the spleen cells must have obtained their foreign material either directly or indirectly from the already ingested leucocytes in the blood. Two ways are open for this to take place. The leucocytes may in some manner discharge their load, which is afterwards taken up by the spleen cells, or the spleen cells may ingest the leucocytes and consequently the carbon. The latter seems to be the most plausible explanation. Moreover from the amount of carbon contained in the spleen cells the number of leucocytes destroyed in this manner must be considerable.

A brief summary of the results of the experiments is contained in the following statements:

1. No free carbon was present in any part examined.
2. All carbon was contained in leucocytes except in the spleen, where true splenic cells also contained it.
3. Ingested cells were both extra- and intravascular, except in the liver.
4. Ingested cells were free on mucous and epidermic surfaces; in the stomach, lungs and skin.
5. Ingested cells were in excretory organs with waste products, kidneys.

From the above results it is seen that the number of leucocytes in the body suffers a constant loss in three ways, by the wandering out of the cells on mucous and epidermic surfaces, by passing away with waste products and through ingestion by the splenic cells. The large numbers found in all three conditions show that the destruction of leucocytes through these ways is by no means insignificant. Moreover as no pathological conditions, so far as could be determined, were induced in the animals by the treatment, there is no reason to believe this loss to be other than a normal occurrence.

This method of removing the artificially introduced material by the leucocytes suggests at least the manner of the removal of any foreign matter that may enter the circulation during life. The leucocytes thus perform the duties of scavengers of the body in addition to their other important duties, even if by

the very assumption of this office, they ultimately become waste material and as such pass away from the system.

One of the most interesting of the many problems that, even in these few experiments, have presented themselves, remains as yet unsolved. Owing to want of time the ultimate fate of the carbon contained in the spleen-pulp cells remains unascertained, nor can any suggestions be offered. Only after more prolonged experiments could it be determined whether the carbon disappeared from the cells or remained permanently in them. After the determination of this point if the first condition was found to obtain, the question as to the method of this removal would remain to be settled. In all the problems connected with the blood and circulation this perplexing organ seems to play an important part and when, setting aside function, differences of opinion exist as to structure, it can easily be seen that discussion on this part of the experiments involves doubtful and difficult problems. As is usual in any investigation many doubtful points have been raised that yet await settlement, leaving an interesting and fruitful field for further work.

NOTE.—The author wishes to express her indebtedness to the American Microscopical Society for the use of plates illustrating this article.

PLATE IV.

Leucocytes.

A. Group of carbon-laden leucocytes showing amoeboid phases.
  a. b. Leucocytes of Necturus.
    n. Nucleus.
    p. Cell-body.
  c. d. Leucocytes of Cryptobranchus.
    n. Nucleus.
    p. Cell-body.
Drawn from dried preparations.

B. Group of Leucocytes, showing amoeboid cell-bodies and amoeboid nuclei.
  a. b. c. Leucocytes of Necturus.
    n. Nucleus.
    p. Cell-body.

- b. Shows three nuclei, two in amoeboid movement and one resting.
- d. e. Leucocytes of Cryptobranchus.
  - n. Nucleus.
  - p. Cell-body.
- e. Has three nuclei, two amoeboid and one resting.

Drawn from stained preparations.

PLATE V.

A. Surface section of liver of Cryptobranchus.
- p. Capillaries of blood-vessels.
- t. Liver-cells.
- b. Red corpuscles in the capillaries.
- d. Small intercellular capillaries of bileduct.
- e. Epithelium of the larger bile vessels.
- h. Hepatic cell-body.
- n. Nucleus of hepatic cells with nucleoli.

Note the absence of extravascular ingested leucocytes.

B. Vertical section of the spleen of Cryptobranchus.
- I. Part of the section near the surface.
  - 1. Peritoneum.
  - 2. Layer of fibrous tissue forming the capsule.
  - 3. Trabeculæ passing from capsule among splenic cells.
  - c. Carbon-laden leucocytes.
  - b. Red corpuscles.
  - l. Leucocytes, non-ingested.
  - s. Splenic pulp-cells.
- II. Ental part of the section.
  Lettering as above.

Note the ingested spleen pulp cells and the different distribution of the carbon particles in them from that found in the leucocytes; also the absence of ingested splenic cells in the superficial part of the spleen.

PLATE VI.

A. Vertical section of lung of Cryptobranchus.
- E. Ectal surface.
- R. Ental or respiratory surface.

P. Blood capillary.
c. Carbon-laden leucocytes.

Note the presence of ingested leucocytes in extravascular tissue as well as on the ental surface of the lung.

B. Section of kidney of Cryptobranchus.
  I. Transection of the ureters and cloaca, showing masses of ingested cells.
    a. Ureters.
    c. Carbon-laden leucocytes.
    l. Non-ingested leucocytes.
  II. Transection of urinary tubules.
    c. Carbon-laden leucocytes.
  III. Nephrostomic funnel, showing ciliated mouth.
    c. Ingested leucocytes.
    l. Non-ingested leucocytes.
  IV. Vertical section of the kidney near the ventral surface.
    G. Glomerulus.
    P. Capillaries of blood-vessels.
    T. Urinary tubules.
    s. Lymph space around the glomerulus.
    o. Origin of a urinary tubules, with small ciliated epithelium.
    b. Red corpuscles.
    c. Carbon-laden leucocytes.

Note the presence of extravascular ingested cells.

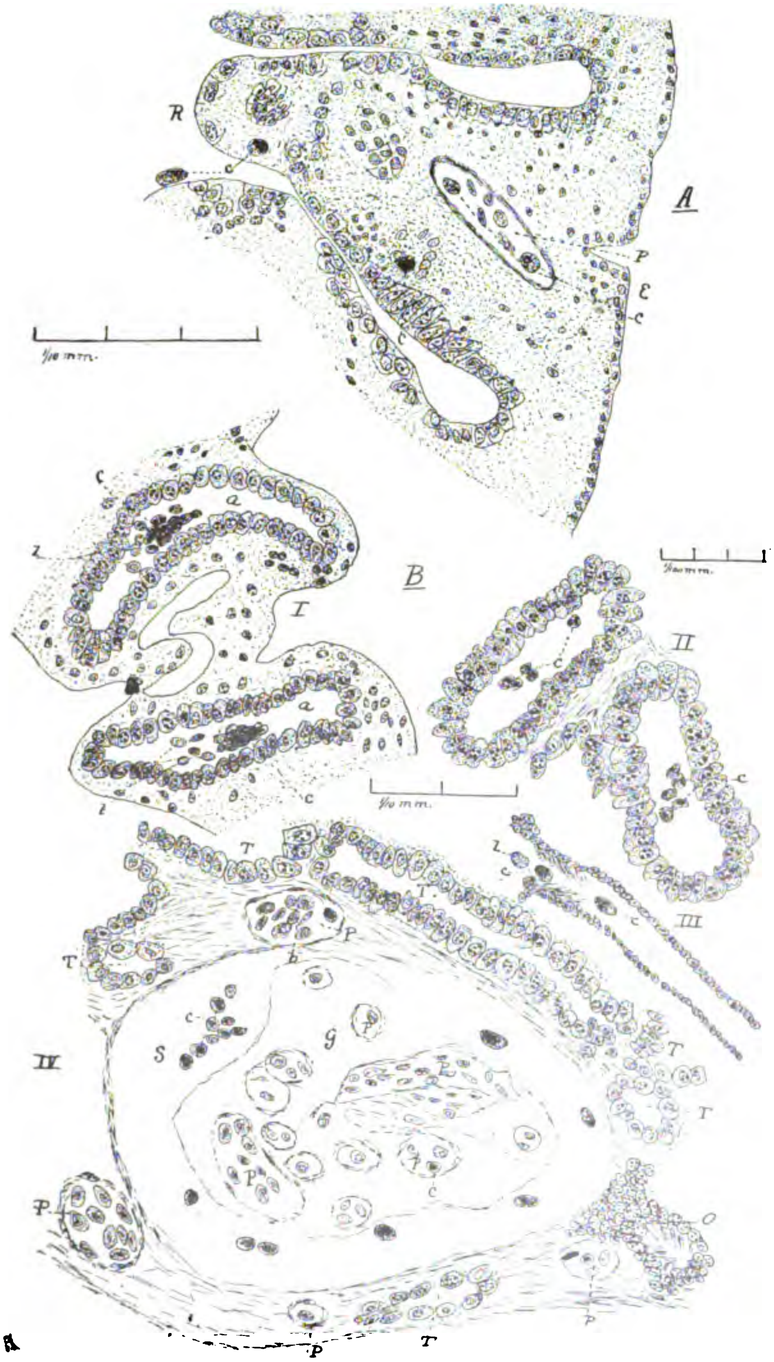
PLATE VII.

A. Vertical section of stomach of Cryptobranchus, near the pyloric part.
  I. Submucosa.
  II. Muscularis mucosæ.
  III. Mucosa.
    c. Carbon-laden leucocytes.

Note the presence of the extravascular ingested cells.

The figure is diagrammatic in so far that the locations of the ingested cells are taken from different sections and put into one figure.

PLATE VI.



Sections of Lung and Kidney of Cryptobranchus.

B. Vertical section of the skin of Cryptobranchus.
 G. Large mucous glands.
 c. Carbon-laden leucocytes.

The ingested cells are wandering to the external surface from the blood-vessels.

THE WHITE-MARKED TUSSOCK-MOTH (ORGYIA LEUCOSTIGMA SMITH AND ABBOTT) IN CHICAGO.

DR. JOSEPH L. HANCOCK.

Throughout the months of June and July 1893, there were myriads of caterpillars of the White-Marked Tussock-Moth (*Orgyia leucostigma*) crawling on the sidewalks, in the grass and in the streets in the section south of the river in Chicago. These caterpillars could be seen constantly changing their positions, drifting from place to place. One need not have searched far to determine the cause of these shifting movements—for the White Elm trees (*Ulmus americanus*) which are set out in some of the resident portions, on the sides of the streets, at that time were almost completely defoliated; showing that they were infested by this insect. As soon as one tree became despoiled of its leaves the caterpillars centered their attacks upon other trees adjacent to them. The beautiful hairy larva of Orgyia marked with yellow, black, and two little bright vermillion red spots on the ninth and tenth joints is a conspicuous object. It seems to have few natural enemies and parasites that are menacing its welfare here.

Notwithstanding the possible existence of a few deadly foes, it enjoys immunity from these to a larger extent than many other insects, as shown from the fact of the growing preponderance of individuals in the last three years. The Wheel-bug sometimes attack the caterpillars, but the former does not occur in the city, whereas bats, cuckoos and robins are in insufficient numbers to make any appreciable impression on them. In the middle or latter part of August, the male moths are most abundant, flying about at night. Attracted by artificial lights, they frequently are seen on the glass of the shop windows along the streets. One appeared on the inside wall of a house (August 28, 1893) and was caught by the writer. The position of the hairy forelegs placed in front of the body,

with other characteristics which it possesses, are attractive to the entomologist. Natural selection has favored the structure of the legs, the feathery antennæ, the subdued ashy-gray color, all to one purpose; to lend in blending its form with the natural environment on the bark of trees. In fact we find

Fig. 1. White-marked Tussock-moth: *a*, female moth on cocoon; *b*, young larva hanging by thread; *c*, female pupa; *d*, male pupa; *e*, male moth. [After Riley].

the caterpillar favored by its very conspicuousness, while nature is effecting good to the same species on a diametrically different line by so modifying the form of the male moth as to deceive its enemies from seeing it. Parasitism may be looked upon as a recent enemy—for nature is strangely unable to cope against their invasion. The female pupa within a frail cocoon may be pierced with ease by the ovipositor of a Hymenopterous parasite and is obliged to give up her life's juices in hopeless submissson to the offspring of the parasite hatching within her body. Along these lines we are to look forward for a means of extermination. On September 30, 1893, the tree trunks along the streets in the locality above named, were examined with a view of learning some further facts about Orgyia. A number of cocoons were found as the result of the search, all being near the ground. These were taken home to my study, where on opening them, they proved to be quite old, of a dirty color, and many were deserted. On two of the cocoons there were plastered masses of small white eggs made adherent by some glistening tenacious frothy substance which had become hardened on drying. Inside of others were empty pupas and cast off skins. Some Hymenopterous parasites had hatched and lived in the old pupa husks, which later had made their exit through an irregular hole cut

out at the forward end. In another cocoon there still lay in store another suprise, for on tearing apart the hairy fibers, out rolled a small undetermined gray spider which was snugly secreted and warmly covered for the winter. The spider was tumbled into a bottle of preserving fluid and now bears testimony to the unprofitable experience of tenanting a ramshackle old dwelling of Orgyia.

RECENT BOOKS AND PAMPHLETS.

Aber, M. A.—Souls. Chicago, 1893. From the Publishers, Donnelly and Sons.

Aby, F. S.—Report on the Microscopic examination of Blood from a patient suffering from Splenic Myelogenous Leukaemia.——Observations on the development of the Hypophysis cerebri and Processus infundibuli in the common cat. Extr. Bull., Lab. Nat. Hist. State Univ. of Iowa, Vol. II, 1893. From the author.

Annual Report of the State Geologist of New Jersey for 1892. From the Survey.

Adler, C.—The Shofar. Its Use and Origin. Extr. Proceeds. U. S. Natl. Mus. Vol. XVI, 1893. From the Smithsonian Institution.

Annual Report of the Board of Regents of the Smithsonian Institution for the year ending 1891. Report of the U. S. Natl. Mus. Washington, 1892. From the Smithsonian Institution.

Bather, F. A.—Natural Science at the Chicago Exhibition. Extr. Natural Science, Nov. 1893. From the author.

Beecher, C. E.—A larval form of Triarthrus.——On the Thoracic Legs of Triarthrus.——Larval forms of Trilobites from the Lower Helderberg Group. Extr. Am. Jour. Sci., Vol. XLVI, 1893. From the author.

Brown, C. T.—Manual of the New Zealand Coleoptera. New Zealand, 1893. From the New Zealand Institute.

Bulletin No. 24, Aug., 1893. Agri. Exp. Stat. Rhode Island Coll. Agri. and Mechan. Arts.

Clark, W. B.—A Preliminary Report on the Cretaceous and Tertiary Formations of New Jersey. Extr. Ann. Rept. State Geol. for 1892. From the author.

Gage, S. H.—The Lake and Brook Lampreys. Reprint from the Wilder Quarter-Century Book, 1893. From the author.

Halstead, B. D.—Report of the Botanical Department of the New Jersey Agricultural Coll. Exper. Stat. for the year 1892.

Harris, G. D.—On the Organic Remains from the Deep Well at Galveston, Texas. Extr. Fourth Ann. Rept. for 1892. From the Texas Geol. Surv.

Hansgirg, Dr. Anton.—Prodomus der Algenflora von Böhmen. Zweiter Theil. Archiv. der Naturw. Landesdurchf. von Böhmen, Bd. VIII, No. 4. From the author.

Hollick, A.—A new fossil Palm from the Cretaceous of Long Island.——Some further notes upon *Serenopsis kempii.* Extrs. Bull. Torr. Bot. Club, 1893.

Holmes, W. H.—The World's Fair Congress of Anthropology, Chicago, 1893. Extr. Am. Anthrop., Oct., 1893. From the author.

Hopkins, T. C.—Marbles and Limestones of Arkansas with Atlas. Vol. IV, Ark. Geol. Surv. for 1890. From Mr. J. C. Branner.

Howes, G. B.—On the Coracoid of the Terrestrial Vertebrata. Extr. Proceeds. London Zool. Soc., 1893. From the author.

Jordan, D. S.—Temperature and Vertebrae. A Study in Evolution. Reprint from the Wilder Quarter-Century Book, 1893.

——Description of a new species of Cyprinoid Fish, *Couesius greeni*, from the head waters of Frazer River in British Columbia. Extr. Proceeds. U. S. Natl. Mus. Vol. XIV, 1893. From the author.

KLAPALEK, PROF. FR.—Untersuchungen über die Fauna der Gewässer Böhmens. Pt. I. Metamorphose der Trichopteren, Archiv. der Naturwissenschaftl. Landesdurchforschung von Böhmen. VIII, Bd., Nrv. 6. Prag, 1898. From the author.

KAFKA, J.—Unterschungen über die Fauna der Gewässer Böhmens. Pt. II. Die Fauna der Böhmischen Teiche. Archiv. der Naturw. Landesdurchf. von Böhmen VIII Bd. Nrv. 2. From the author.

LYMAN, B. S.—The Great Mesozoic Fault in New Jersey. Extr. Proceeds. Am. Philos. Soc., 1893. From the author.

MANN, A.—List of Diatomaceae from a Deep-sea dredging in the Atlantic Ocean off Delaware Bay by the U. S. Fish Commission steamer Albatross. Extr. Proceeds. U. S. Natl. Mus. Vol. XVI, 1893. From the Smithsonian Institution.

MASON, O. T.—Throwing-sticks from Mexico and California. Extr. Proceeds. U. S. Natl. Mus. Vol. XVI, 1893. From the author.

MATTHEW, W. D.—On Antennae and other Appendages of *Triarthrus beckii*. Extr. Trans. N. Y. Acad. Sci. xii, Amer. Journ. Sci., 1893. From the author.

OSANN, A.—Report on the Rocks of Trans-Pecos Texas. Extr. from the Fourth Annual Report, 1892. From the Texas Geol. Surv.

PARKER, E. W.—Production of Coal in 1892. Extr. Mineral Resources of the U. S. calender year 1892. From the U. S. Geol. Surv.

RATHBUN. M. J.—Catalogue of the Crabs of the Family Maiidae in the U. S. Nat. Mus. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

Studies from the Johns Hopkins University, Vol. V, No. 2 and 3.

RIDGWAY, R.—Descriptions of some new Birds collected on the Islands of Aldabra and Assumption, northwest of Madagascar, by Dr. W. L. Abbott,

——On a small collection of birds from Costa Rica. Extr. Proceeds. U. S. Natl. Mus. Vol. XVI, 1893. From the Smithsonian Institution.

RILEY, C. V.—Report on the Insecta, Arachinda and Myriapoda collected during the U. S. Eclipse Expedition to West Africa in 1889–90. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

ROMANES, G. J.—An Examination of Weismannism. Chicago, 1893. From the author.

ROSE, C.—Ueber die Zahnentwicklung der Krokodile. Abdruck aus Verkandl. Anat. Gesellsch. Wien 1892.——Uber die Zahnleiste und die Eischwiele der Sauropsiden.——Uber die Zahnnentwickelung der Beuteltiere.——Uber rudimentäre Zahnanlangen der Gattung Manis. Abdruck aus Anat. Aug., 1892. Zur Phylogenie des Säugetiergebisses. Sonderabdruck aus Biologisches-Centralb. 1892. From the author.

RUSSELL, I. C.—Malaspina Glacier. Extr. Journ. Geol., Vol. I, 1893. From the author.

SALISBURY, R. D.—Surface Geology of New Jersey. Extr. Ann. Rept. of New Jersey State Geologist for 1892. From the author.

SCHLOSSER, M.—Ueber die Deutung des Milchgebisses der Säugethiere. Verhandl. d. deutsch. odontol. Gesellschaft. Bd. IV. From the author.

SEELEY, H. G.—On a Reptilian Tooth with two Roots.——Supplemental Note on a Double-rooted Tooth from the Purbeck Beds. Extrs. Ann. & Mag. Nat. Hist., 1893.

——Further observations on the shoulder girdle and clavicular arch of the Ichthyosauria and Sauropterygia.——Researches on the Structure, Organization and Classification of the Fossil Reptilia, Part VIII. On further evidence of Deuterosaurus and Rhopalodon from the Permian Rocks of Russia. Extrs. Proceeds. Roy. Soc., Vol. 54. From the author.

SIMPSON, C. T.—On some fossil Unios and other fresh water shells from the drift at Toronto, Canada, with a review of the distribution of the Unionidæ of northeastern North America. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

SINGLEY, J. A.—Preliminary Reports on the Artesian Wells of the Gulf Costal Slope. Extr. Fourth Ann. Report, 1892. From the Texas Geol. Surv.

SMYTH, B. B.—Check List of the Plants of Kansas. Topeka, Kansas, 1892. From the author.

STEJNEGER, L.—Notes on a third installment of Japanese birds in the Science College Mus., Tokio, Japan, with descriptions of new species. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

STREERUWITZ, W. H.—Trans-Pecos Texas. Extr. from Fourth Annual Report for 1892. From the Texas Geol. Surv.

Transactions Kansas Academy of Science, Vol. XIII, 1891–92.

TROUESSART, E.—Les Primates tertiaries et l'Homme fossile sud-amèricain. Extr. L'Anthropologie, 1892. From the author.

TRUE, F. W.—Description of a new Fruit Bat, *Pteropus aldabrensis*, from Aldabra Island.

——Notes on a small collection of Mammals from the Tana River, East Africa, with descriptions of new species. Extrs. Proceeds. U. S. Natl. Mus., Vol. XIV, 1893. From the Smithsonian Institution.

RECENT LITERATURE.

Chapman on the Birds of the Island of Trinidad.[1]—During the early part of 1893, Mr. Chapman collected birds and made notes in the Island of Trinidad, and the paper we are here to notice is the printed account of his observations in that interesting quarter of the world. Its author leads off with a brief description of the Island and the various places upon it visited by him during his short stay there. Then follows several pages devoted to "The Faunal Position of Trinidad," in which he very conclusively proves that that island "faunally, that is naturally, has no connection whatever with the West Indies, but is entirely South American in its affinities." Further we are informed that an "analysis of the distribution of the 199 resident land-birds common to Trinidad and the continent shows that it belongs in the Colombian, rather than in the Amazonian subregion. Thus 153 of these birds are found in both Guiana and Venezuela, while twenty-five are found in Venezuela but not in Guiana, and only eleven are found in Guiana but not in Venezuela." An interesting table is also given showing the South American element in the avifauna of Trinidad, as compared with the off lying islands of Tobago and Grenada.

Mr. Chapman also deals in this paper with the Bibliography of the Trinidad Avifauna, and an entire and very important section of the work is devoted to "General Remarks on Trinidad Bird Life." Here the questions of "Number of Species;" "Migration;" "Call-Notes and Songs;" "Nesting" and "The Colors of Tropical Birds" are dealt with in a manner well calculated to excite the interest, and compel the attention of the philosophic student of bird-life in any part of the world where these observations may be read.

This memoir is concluded by "A List of the Birds of the Island of Trinidad," which is prefaced by the following remark by its author: "While I believe that the most natural order in which to arrange lists of species of any class of animals is to begin with the lowest forms and end with the highest, most writers on South American birds have followed exactly the opposite plan, and any attempt to change would now result in so much confusion that I have decided to follow the system of

---

[1] CHAPMAN, FRANK M., *On the Birds of the Island of Trinidad.* Author's Ed. ext. Bull. American Museum of Natural History, Vol. VI, Art. 1, pp. 1–86. New York, Feb. 16, 1894.

previous writers, even though I disapprove of it." (p. 21). We cannot agree with Mr. Chapman in this theory, and see no real valid reason why we should perpetuate the errors of our predecessors in the science of ornithology.

The classification of the birds of Trinidad adopted by Mr. Chapman is the only faulty feature of this otherwise careful work by a Naturalist who has thus far in his career earned a reputation for great painstaking.

He divides the Trinidad avifauna simply into two primary ORDERS —the PASSERES and the MACROCHIRES.

In the first named the following families are represented, viz: the *Turdidæ;* the *Troglodytidæ* [Sic.]; the *Mniotiltidæ;* the *Cœrebidæ;* the *Vireonidæ;* the *Hirundinidæ;* the *Tanagridæ;* the *Fringillidæ;* the *Icteridæ;* the *Tyrannidæ;* the *Pipridæ*; the *Cotingidæ*; the *Dendrocolaptidæ;* and the *Formicariidæ.*

This may answer for the Passeres, but his order Macrochires is very carelessly arranged. In it he retains the "Humming-birds, Swifts, Goat-suckers, etc.," and leads off with the family *Trochilidæ,* between which and the Swifts there appears no family dividing line; nor is there between the Swifts and the Goat-suckers. The "etc." given above seems to include also without dividing family lines, Wood-peckers, Kingfishers, Trogons, Jacamars, Cuckoos, Toucans, Parrots, Owls, Vultures, Hawks and Pigeons, Jacamas, and indeed all the rest of the avifauna of the Island, including all the water-birds. At the close of the "list" some of the birds are enumerated entirely in their wrong places in the system. I refer to the point where *Crypturus pileatus* follows *Colymbus dominicus.*

The writer of this review has long since failed to recognize the naturalness of the so-called order "Macrochires," but here certainly is an application of it that is, at the best, quite unique in ornithological literature.—R. W. SHUFELDT.

Memoirs of the National Academy of Sciences, Vol. VI,[1] embraces 331 pages, of which the following is the list of contents;—On the Capture of Comets by Planets, especially their Capture by Jupiter, by H. A. Newton.—Atmospheric Electricity, by Robert Catlin, U. S. A.—On Certain New Methods and Results in Optics, by C. S. Hastings.—The Proteids or Abuminoids of the Oat Kernel, by T. B. Osborne.—A Comparison of Antipodal Faunas, by Theodore Gill.—Families and Sub-Families of Fishes, by Theodore Gill.—Human

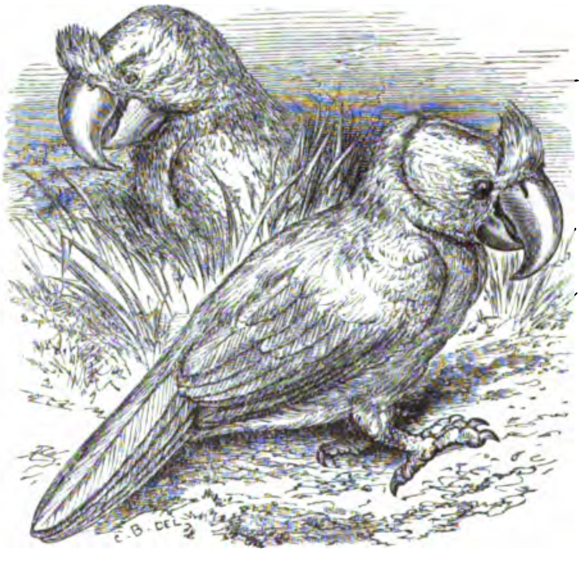
---

[1] Memoirs of the National Academy of Sciences, Vol. VI. Washington, 1893.

Bones of the Hemenway Collection in the U. S. Army and Medical Museum, by W. Matthews, Surgeon, U. S. A., Dr. J. L. Wortman and Dr. J. S. Billings.—Further Studies on the Brain of *Limulus polyphemus*, with notes on its Embryology, by A. S. Packard.

Four of the eight memoirs are profusely illustrated.

A Dictionary of Birds.[3]—Under this title, Professor Newton publishes a series of articles contributed to the ninth edition of the Encyclopedia Britannica, modified and supplemented by recent acquisitions to the knowledge of the Avian history. The contributions of Dr. Gadow bring the anatomical portion up to date, and those of Dr. Lydekker furnish the paleontology. The material is arranged in alphabetical order and includes the names of birds in common use, excluding local names except such as have found their way into some sort of literature; technical terms; and all of the important branches of Ornithology; as flight, migration, extermination, embryology, eggs. color, geographical distribution, etc.



Lophopsittacus mauritianus M-Edw.; the extinct parrot of Mauritius.

The numerous illustrations add to the attractiveness of the work. Many of those representing the bill, wings and feet, are those pub-

---

[3] A Dictionary of Birds, by Alfred Newton; assisted by Hans Gadow; with contributions from R. Lydekker, C. S. Roy and R. W. Shufeldt. Pt. I and II. London, 1893, Adam and Charles Black, Publishers.

lished many years ago by Swainson, which have never been excelled for expressiveness.

The Dictionary is one which every Naturalist should have at hand, as furnishing in convenient form full information in every department of the subject. The work is critical, and the conclusions of its authors carry with them the weight of their well known mastery of the subject. The treatment of questions of nomenclature is especially to be commended. As they insist on correct orthography, and discard names published without descriptions, or which are flagrantly incorrect in meaning, they furnish a much needed corrective to tendencies to pursue an opposite course, which are just now too prevalent in this country. We give some examples of the cuts which illustrate the two volumes already issued.

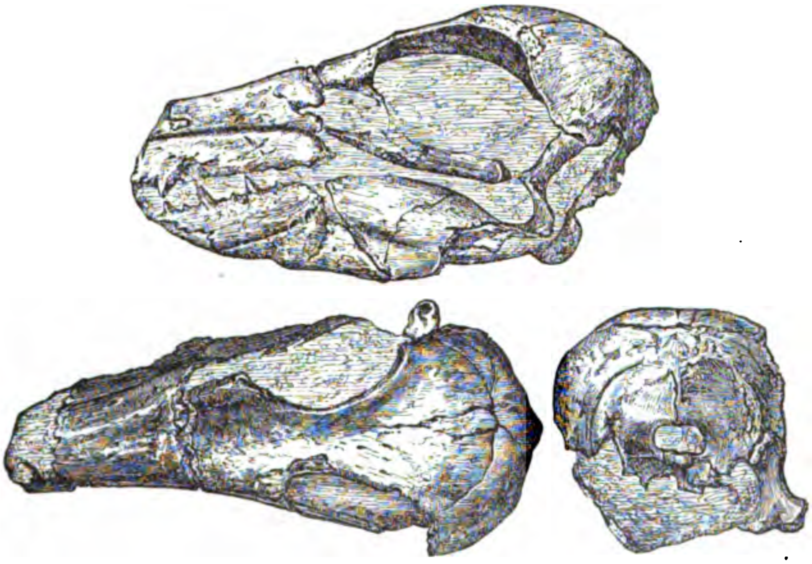


FIG. 1. *Odontopteryx toliapicus* Owen. English Eocene.

Eleventh Report of the State Mineralogist of California.[4] —This report, as originally submitted to the Board of Examiners, consisted of over 2,000 pages of manuscript, much of which, while valuable in itself, would be of no practical use to the miners in whose interest the volume was prepared. It was accordingly put in the hands of Mr. Charles G. Yale for revision. By judicious omission and conden-

---

[4] Eleventh Report of the State Mineralogist, Wm. Ireland, Jr. (First Biennial) Two years ending September 15, 1892. Sacramento, 1893.

sation he reduced the copy to 844 pages of manuscript which, together with the illustrations, makes an octavo of 612 pages. The report is confined almost exclusively to mining in the counties of California, the exceptions being a paper on Hydraulic Ejectors, by Mr. E. A. Wiltsee, and a dissertation upon American mining law, by A. H. Ricketts.

The prefatory report of Mr. Ireland includes an interesting synopsis of the results of the geological investigations of the different field assistants.

The engravings for this report add materially to its value.

Annual Report of the Canadian Geological Survey, 1890–91.[5]—This volume, of 1,556 pages, consists of 13 separate reports, bound in two parts, with maps and illustrations descriptive of the geology, mineralogy and natural history of the various sections of the Dominion to which the several reports relate. These have been published separately at intervals during the past two years, and abstracts of many of them have been given in previous numbers of this journal

Eleventh Annual Report of the Director of the U. S. Geol. Surv.[6]—This volume contains a report of the work of the divisions of Hydrography and Engineering during 1889–90, the statement of the Director to the House Committee on Irrigation, the report of Mr. A. H. Thompson, geographer, and an account of the disbursements of money. The statement of the Director comprises a general discussion of the problems of irrigation in the arid lands of the United States, and a résumé of the larger aspects of the problem, as well as other facts of general interest.

The text is illustrated by several maps and cuts of measuring instruments in use by the Survey.

Annual Report of the New Jersey Geological Survey for 1892.[7]—The investigations carried on in the several departments of the Survey are embodied in the report of the State Geologist under the following heads: Surface Geology, R. D. Salisbury; Cretaceous and and Tertiary Formations, W. B. Clark; Water-Supply and Water-

---

[5] Annual Report Geological Survey of Canada, 1890–91, Vol. V. Parts 1 and II. Ottawa, 1893.

[6] Eleventh Annual Report of the U. S. Geol. Surv. to the Secretary of the Interior, 1889–90. By J. W. Powell, Director. Part II, Irrigation. Washington, 1891.

[7] Annual Report of the State Geologist of New Jersey for 1892. Trenton, N. J., 1893.

Power; C. C. Vermeule; Artesian Wells, L. Woolman; The Sea-Dikes of the Netherlands and the Reclamation of Lowlands and Tide-Marsh-Lands, J. C. Smock.

In the administrative report, Mr. Smock calls attention to the desirability of securing the Highlands for a forest reservation, and a permanent gathering territory for a water-supply, and refers somewhat at length to the subjects reported upon by the heads of the several divisions.

The illustrations consist of maps, diagrams and plates. Among the latter are three reproductions from the Challenger Expedition Report on Deep Sea Deposit.

Marbles and Limestones of Arkansas.[8]—This report, by T. C. Hopkins, represents Volume IV of the Annual Rept. of the Arkansas Geol. Surv. for 1893. Part I consists of an introductory chapter giving a general description of the marble area of the State, followed by a discussion of limestones in general, including their composition and origin, geological and geographical distribution, varieties and uses, and a detailed description of the different limestones of Arkansas. In part II the author states briefly the origin and uses of marble, gives a résumé of the marbles of United States and other countries, and describes in detail those of Arkansas, giving especial attention to their use for building purposes. In order to make the work of practical value in establishing a marble industry in the State, two chapters are devoted to quarrying and the preparation of the stone.

The text is illustrated by a number of good plates, and a set of six map sheets.

---

[8] Annual Report of the Geological Survey of Arkansas for 1890. Vol. IV, Marbles and other Limestones. By T. C. Hopkins, Little Rock, Ark., 1893.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Discovery of a New Fauna in the Cenozoic Beds near Zagreb, and its Relations with the Recent Fauna of the Caspian Sea.—For a number of years, Professor Brusina of the University of Zagreb has been studying the Molluscan fauna of that region. In a recent publication he reports finding a wonderfully rich fossil bed at Markusevic from which he obtained 101 species, over half of which are new. A generic comparison of the fauna of Markusevic with that of Okruljak shows that the Pelecypoda are the dominant type in the latter locality, while the gasteropods prevail in the former. A comparison of the fauna of these two localities in Croatia with the recent fauna is of extreme interest. To quote Professor Brusina, "They seem to have relations with the fauna of Lake Baikal; my new genus, Baglivia, is similar to the genus Liobaikalia Martens (Leucosia Dybowski). Also some of our Valvata recall some species of the same genus which live in Lake Baikal.

"I have mentioned the genus Caspia. Dr. W. Dybowski, to whom we are indebted for the most important papers on the Gasteropods of Lake Baikal and of the Caspian Sea, created this genus for a series of small species which live in the Caspian Sea. Now, I have discovered near Zagreb several fossil species of the same genus. In a paper published in 1884, I established the genera Zagrabica and Micromelania for some fossils found near Zagreb; in 1891, in the work referred to on the recent Molluscs in the Caspian Sea, Dybowski describes several species of Micromelania and one species of Zagrabica now living in that sea. Thus, the genera Zagrabica, Micromelania, Caspia and Limnocardium (Adacna), fossil in Croatina, are to-day living in the Caspian Sea. It is, then, evident that the present fauna of this sea is the remnant of the rich fauna of the Congeria beds of Austria, Hungary, Banat, Croatia, Slavonia, Servia, etc., although, quite recently this fact has been doubted.

"A comparison between the fossil fauna of the neighborhood of Zagreb with the recent fauna of the Caspian Sea destroys the hypotheses of Humboldt, Peschel, Middendorf and others, concerning the origin and relationship of the Caspian Sea and of its present fauna. While these authors claim the origin of the fauna of the Caspian Sea, in the Black and circumpolar seas, my studies and my researches lead me to look for its origin in the pre-pleistocene Cenozoic beds of Croatia

and in those of the other countries above cited." (Proceeds. Congrés. Internatl. de Zool. Deuxiéme Sess. a Moscou, 1892. Deuxième Partie Moscou, 1893.)

Coasts of Bering Sea and Vicinity.—Mr. G. M. Dawson's notes on some of the coasts and islands of Bering Sea confirm the theory of a former land connection of Asia and North America in that region. Soundings in Bering Sea show that the continental plateau of North America extends westward in Bering Sea, meeting with that of Asia in the vicinity of Cape Navarin, north latitude about 60°. The available evidence shows that this submarine plateau, together with much of the flat land of western Alaska, was covered by a shallow sea during the later part of the Miocene period. The formation of the Aleutian Islands began in the late Eocene or early Miocene, continued with vigor during Miocene, and later in an intermittent way up to the present time. No traces of glaciation by land ice were found in the Bering Sea region, and the absence of erratics above the sea-line shows that it was never submerged for any length of time below ice-encumbered waters. (Bull. Geol. Soc. Am. Vol. 5, 1894).

The Age of the Pliocene Mammalian Fauna of the Central Plateau of France.—M. Deperet recognizes two distinct and successive mammalian faunas in the different Pliocene horizons of Italy, France and England. First, an older one, belonging to the lower and middle Pliocene. It is characterized by a great number of old extinct forms, as Hippotherium, Hyaenarctos, Paleoryx, Dolichopithecus, many of the Glires, large Monkeys with Asiatic affinities, Antilopes related to the African species, and by the rarity of the relative simplicity of the horns of the Cervidæ. The absence of Equus, Bos and Elephas constitutes a negative character throughout all Europe. Second, a more recent fauna, found only in the upper Pliocene. The old genera, except the Mastodon, have disappeared; the horse supplants Hipparion; Bovidæ appear for the first time in Europe; Monkeys persist in Italy; *Elephas meridionalis* is found nearly everywhere with *Mastodon arvernensis* and *M. borsoni.*

In Italy the old fauna is badly represented by sporadic débris, but the recent types are found abundantly in the brackish and fluviatile deposits which overlie the marine Pliocene of Astesan, and in the fluviatile gravels in the valley of the Arno.

In the south of France the older fauna occurs and affords the best means of determining the exact stratigraphic position of the beds in which the fossils are found.

In la Bresse the older fauna is found in the lacustrine deposits of the lower Pliocene and in the fluviatile beds of the middle Pliocene; the recent fauna is finely developed in the sands of Chagny.

In England the Hipparion fauna is found in the nodule-beds at the base of the red Crag and in the red Crag itself, while the Equus fauna is contained in the fluvio-marine Crag.

A comparison of stratigraphic details shows that the older Pliocene fauna is lacking in the Central Plateau region of France, and the horizon of Perrier with the Mastodon bearing sands of Puy, of Coupet and of Vialette must be placed in the upper Pliocene not withstanding the total absence of *Elephas meridionalis.*

The fauna of Sainzelles presents the same characters as that of Perrier and can be considered only as a simple local sub-division of the same bed.

From these facts M. Deperet also concludes that the basalts intercalated in the gravels of Perrier and the Mastodon-bearing sands of Puy, and the breccias which accompany them, belong to the upper Pliocene, and, chronologically, are very near to the basalts of the Plateau. (Compte-rendu des Séances de la Soc. Geol. de France, 1893.)

Plistocene Diastrophism in the California Coast.—Mr. A. C. Lawson has obtained data which establishes (1) The uplift from the sea of the entire coast of California from San Francisco to San Diego, in Plistocene time, from 800 to 1500 feet. (2) A differential movement of the crust, to a remarkable degree, in the vicinity of Catalina Island, and near the city of San Francisco, also of Plistocene age.

The uplift changed the contour of the coast, which at the close of the Plistocene had had the aspect of an archipelago and was well supplied with harbors. The Channel Islands are remnant of the Pliocene condition, but the harbors have disappeared with one exception.

The orogenic movement resulted in the lifting of the Merced series, into its present condition and the upthrust of the Montara Mountain, which is described as having a central granite mass from which the strata of all ages dip quaquaversally. The mass antedates the oldest sedimentary strata on its flanks. In his conclusions the author states that the subdivisions Eocene and Neocene are not suited to the west coast of California. The reversal of the epeirogenic movement from a process of depression to that of uplift is believed to correspond

PLATE VII.

Sections of Stomach and Skin of Cryptobranchus.

with the beginning of the Plistocene, so there was no break in the marine conditions throughout the epochs, the Pliocene merging into the Plistocene. Between the Pliocene and Miocene, however, there was an important interval of erosion. (Bull. Dept. Geol. University of California, Vol. 1, 1893.)

Geological News.—PALEOZOIC.—Mr. M. R. Campbell's stratigraphical studies in Montgomery and Pulaski Counties in western Virginia, result in the establishment of two periods of disturbance in the Appalachian system. One folded the limestones and produced basins at the beginning of the Devonian period, the other elevated these basins and brought the period of sedimentation in them to a close near the middle of the lower Carboniferous period. These two periods of disturbance, in connection with other well established periods of overlaps show that deformation in the Appalachian system has been practically continuous since early Paleozoic time. (Bull. Geol. Soc. Am. Vol. 5, 1894.)

MESOZOIC.—Dr. J. W. Gregory describes two new species of Chilostomata (*Membranipora jurassica* and *Onychocella bathonica*) from the Jurassic beds of Normandy, France. This is the first description of Polyzoa of this order in the Jurassic. (Geol. Mag., Feb., 1894.)

From the evidence of fossil flora and certain stratigraphical facts, Mr. Benjamin Smith Lyman is inclined to put the Newark Brownstone at an earlier age than Mesozoic. Since the recent researches of Canadian geologists have proved that much of the so-called Trias of New Brunswick and Nova Scotia is really Permian and even Carboniferous, the author calls attention to the doubtful determination of the age of the beds in question, and suggests a thorough examination of the paleontological record in order to determine their position. (Proceeds. Amer. Philos. Soc. Vol. xxxiii, 1894.)

CENOZOIC.—The age of the yellow clay in the eruptive formations of Gravenoire, in which a human skeleton was found in 1891, has been fixed by MM. Girod and Gautier. A study of the stratigraphy and fauna of that region leads to the conclusion that the bed in question is a post-glacial deposit of the Reindeer age. (Rev. Scientifique, Feb., 1894.)

The collection of Bird bones from the Miocene of Grive-St. Alban, France, sent by Dr. Forsyth Major to Mr. Lydekker for identification, comprises six determinable species, of which four are new: *Strix sanctialbani*, *Palæortyx maxima*, *P. grivensis*, *Totanus major*. The

specimens of *Strix sanctialbani* confirm Mr. Lydekker in the view that the Strigidæ must be subdivided into the families Strigidæ and Bubonidæ. (Proceeds. Zool. Soc. London, 1893.)

According to Mr. F. L. Ransome, the eruptive rocks of Point Bonita, California, are differentiated into two formations which, from chemical analysis, seem to have been derived from the same basic magma. One is compact, amygdaloidal, does not show crystals to the unaided eye and is markedly spheroidal in structure; the other is distinctly crystalline, traversed by irregular joint planes, and is not spheroidal. The latter is intrusive into the sandstones and is, therefore, of later age. The spheroidal basalt was probably poured out anterior to the deposition of the sandstone and afterwards elevated to its present position. The author believes the spheroidal structure to be a flow phenomena. The lava issued in a viscous condition, one sluggish outwelling of lava being piled upon another to form the whole mass of the flow. The former center of volcanic activity, as indicated by the character and position of these formations, probably lay to the seaward at some little distance off the present coast. (Bull. Dept. Geol. Univ. of California, Vol. 1, 1893.)

BOTANY.[1]

Holophytes and Hysterophytes.—For some time I have been using in my lectures, and occasionally in some botanical writings which have not yet appeared in print, the two words here given.

Every botanist has felt the need of a word which should express what we mean when we say "a green plant," or a "chlorophyll-bearing plant," and he has felt even more the need of a single term to express what he means when he says a "parasite or saprophyte," a "parasitic or saprophytic plant," or a "chlorophyll-less plant." The terms I have used are not strictly new. We already have "holophytic" with precisely the meaning I would give this form of the word. Hysterophyte has often been used with nearly the meaning I would restrict it to, and its older use has practically become obsolete. The words may well be restricted then as follows: "holophyte," a chlorophyll-bearing plant, which is neither parasitic nor saprophytic, i. e., an independent plant so far as its nutritive functions are concerned; "hysterophyte" a chlorophyll-less plant, either a parasite or a saprophyte, i. e., a dependent plant so far as its nutritive functions are concerned. The etymologies are so evident that I need not give them here.

Charles E. Bessey.

The Microörganisms of Fermentation.[2]—The name of Professor Emil Chr. Hansen is connected with a reform in the industry based upon fermentations. The reform is spreading all over the civilized countries, and it is gradually entering into the wine-industry, and, recently, into the manufacturing of vinegar. Hansen's principle is to work in the brewery with *pure yeast*, and this principle will doubtless be extended to other manufacturing trades the underlying causes of which are life-activities of microörganisms.

The famous Carlsberg Laboratory, where Hansen works, and from where the Kjeldahl nitrogen method sprung, could, a few years ago, not accomodate all of the students that came from all parts of the world. Consequently Hansen's collaborator, Alfred Joergensen,

---

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska,

[2] Joergensen, Alfred; Microörganisms and Fermentation. New edition, translated from the re-written and much enlarged third edition in German by Alex. K. Miller, Ph. D., F. I. C., and E. A. Lennholm, and revised by the author. With 56 illustrations. London, F. W. Lyon, Eastcheap Buildings, E. C., 1893. (pp. VIII + 257, 9x6).

established a laboratory for the purpose of giving specialists an opportunity of becoming acquainted with the new system, and, at the same time, supplying cultures to breweries. While Hansen worked mainly in the line of bottom fermentation, Joergensen worked with top fermentations.

All we who have had an opportunity of working with Joergensen, are well acquainted with his text-book ; it is as thorough as its author and as familiar to us as our catechism.

Chapter I treats of microscopical and physiological examinations in the line of lower cryptogams; Ch. II of examinations of air and water, including Hansen's zymotechnical analysis of air and water ; in Ch. III bacteria form the subject; Ch. IV contains the moulds, Ch. V (pp. 111–203) contains a full account of the alcoholic ferments, methods of analysis in this special line, and descriptions of the different species of Saccharomyces and their nearest relatives. In Ch. VI the application of the results of scientific research in practice (pp. 204–227) is set forth, and a bibliography and an index have finally been added.

Botanists are, as a general rule, too much absorbed by the questions of nomenclature, etc., to look into practical questions ; therefore, we often see, in text-books, very singular remarks on the subject of fermentations. A book like Joergensen's text-book should not be absent from any laboratory, chemical or botanical, because fermentations are subjects of study in both places, and because the work in these lines is very instructive, both to botanists and to chemists. To the special attention of all of these, the book of Joergensen is most cheerfully recommended.

J. CHRISTIAN BAY.

ZOOLOGY.

The Cestodes of Herbivorous Animals.[1]—Dr. C. W. Stiles and Albert Hassall have issued a well illustrated list of the adult tape worms of cattle, sheep and allied animals. In this work the authors have had the great assistance to be derived from studying many of the original types. From this paper we learn that the domestic cattle are infested by 8 adult cestodes, the goat by 2, the sheep by 11, etc. The new species described are *Monezia oblongiceps* from a South American Coassus, *M. trigonophora* from sheep, and *M. planissima* from sheep and cattle. In connection with each species is a good anatomical description.

Cladoceran Crustacea.[2]—Prof. E. A. Brige, in the third of his "Notes on Cladocera," enumerates 63 species of Cladocera as having been found in Wisconsin and Northern Michigan. A table is given showing the distribution of each species in the lakes explored, and four plates illustrate the new or little known forms enumerated. The new species are *Moina affinis, Ceriodophina lacustris, Daphinia breviceps, Bunops* (n. g. for *Macrothrix serricaudata* Daday and *B. scutifrons* nov.) *Chydorus faviformis, Anchistropis minor.* A most interesting comparison is made between the Cladoceran fauna of Wisconsin and various regions of Europe.

Eyes of the Harvestmen.—Dr. Frederick Purcell has just issued an account of the eyes of the Phalangids[3] which is rather difficult to understand, on account of the absence of all illustrations. The Phalangids have two eyes which Purcell homologizes, without a doubt, with the median eyes of the scorpions. Like them, they are developed from three layers, the middle forming the inverted retina. The retinulæ each consist of five cells arranged in a circle and each retinular cell gives rise to a rhabdomere so that the rhabdom is five-parted and the longitudinal grooves on the outer surface of each rhabdomere give it a star-like section. The retinal cells are pigmented distally, the nucleus and nerve termination are in the proximal portions. Besides these there are club-shaped pigment cells in the dis-

---

[1] U. S. Dept. Agric., Bureau of Annual Industry, Bulletin, 4, 1893.

[2] Trans. Wisc. Acad. Sci. Arts, IX, 1893.

[3] Ueber den Bau der Phalangiden Augen; Dissertation. Berlin, 1894.

tal retinular region. The principal differences between these eyes and the middle eyes of the scorpion lie in the absence of a central cell, in the anatomy of the retinulæ and in the absence of inter-retinular pigment cells from the Phalangids. As a summary Purcell says: "The anterior middle eyes of the spiders, the eyes of Phalangids and the middle eyes of the scorpions, as well as the middle eyes of Limulus, represent a series of homologous structures, which are characterized by an inverted retina with retinulæ or at least rhabdomes."

Range of Placostylus.—A study of the geographical distribution of the land molluscan Placostylus, by Mr. C. Hedley, leads to some interesting conclusions. According to that author, Wallace's theory of a land connection between Australia and New Zealand is untenable. Mr. Hedley's theory is that the various islands where Placostylus is found, embracing the archipelagoes of Solomon, Fiji, New Hebrides, Loyalty, New Caledonia, Lord Howe and New Zealand, are the remnant of a continental area to which he gives the name, Melanesian plateau. This plateau was never connected with nor populated from Australia; its fauna was probably derived from Papua via New Britian. New Zealand and New Caledonia were early separated from the northern archipelagoes, while the Fijis remained to a later date in communication with the Solomons, but were severed from that group before the latter had acquired from Papua much of its present fauna.

The author calls attention to the fact that not the depth but the permanence of the ocean is the real limit to the distribution of the forms of life. (Proceeds. Linn. Soc. N. S. W., 1892).

The Scales of Lepidosteus.[4]—Mr. W. S. Nickerson finds that in *Lepidosteus* the dermal scleroblasts give rise to three different products: (1) calcareous scale material, (2) ganoine, and (3) a ganoine membrane. There is no differentiation of the cells, but rather a modification of the function of the same cells at different periods of their history. The ganoine has been called the enamel layer, but it is not enamel, as its development and chemical reactions show. It is secreted on the outer surface of the scale by cells of dermal origin, not by epidermal cells, as is the case with true enamel. The epidermal cells over it are unmodified and separated from the scale by a dermal layer of cells. Such a condition is found no where else among vertebrates.

During the development of the scale, spines tipped with an enamel layer are formed, but disappear before the maturity of the scale. Their number and irregularity of distribution over the scale opposes

[4] Bull. Mus. Comp. Zool., XXIV, No. 5 (1893).

the supposition that the ganoid scale is a number of placoid scales used together. There can be no homology between them except in their both being dermal structures. In the Selachians the basal plate originated in connection with the formation of spines, but in the Lepidosteus the spines have degenerated while the basal plate has developed independently at the same time sinking deeper in the dermis.

In the Telosts there is no ganoine, but a modification of the dermis takes place similar to that in *Lepidosteus.* The same sinking or a tendency to reduction of superficial parts and increase of the deeper parts, involving the reduction of spines. In the lower Teleosts the spines are connected with the scale by connection tissue only, thus showing a more degenerate condition than in Lepidosteus.

It appears, then, that the Lepidosteus and Teleost scales have been derived from the placoid scale along independent lines.—F. C. KENYAN.

Mammalia of Mt. Pocono.—Considering the fact that hitherto no systematic collecting of small mammals has been attempted in the Pennsylvania mountain districts the following notes may seem worthy of record. During the latter part of June and first week of July, 1893, in company with Mr. Witmer Stone, I spent about ten days collecting birds and mammals in the vicinity of Mt. Pocono, Monroe Co., Penna. The general situation and elevation of the locality warranted a much more northern fauna than that found in the southeastern part of the state, and it is hence not at all surprising that such boreal forms as *Zapus insignis, Evotomys gapperi* and *Tamias striatus lysteri* were obtained. None of these, so far as I am aware, have been previously recorded from Pennsylvania.

A list of the mammals collected is as follows:

Blarina brevicauda.—This shrew was the most abundant of any species noted; the specimens secured forming over 30 per cent of the whole number collected. I found them, as Dr. Merriam has said, moving about during the day, and on my afternoon visit to the traps rarely failed to secure one or more. Several were taken in the same runs with *E. gapperi.*

Sorex platyrhinus (Dobson).—Two specimens of a small shrew were secured which Mr. G. S. Miller, Jr. has kindly referred for me to this species, using the name as a provisional designation. A third specimen, badly decomposed, was found in the middle of a road through the woods. Of this the skull only was preserved.

Evotomys gapperi.—Five specimens of the red-backed mouse were

secured, of which four were taken in decayed stumps, and the fifth in a runway under a log.

Sitomys americanus.—A young male and female in plumbeous gray pelage, with a narrow streak of brown on the flanks were the only ones collected.

Arvicola pinetorum.—Two specimens were secured under a log.

Zapus insignis.—An adult male of this handsome mouse was secured July 4th, on the bank of a stream in a ravine covered with a growth of hemlocks and laurels.

Tamias striatus lysteri.—We found this chipmunk quite common among the rocks and young growths where the timber had been recently destroyed by fire. The specimens collected, on comparing them with skins from Maine, were found to be typical *lysteri*.

Sciurus hudsonius.—A tolerably common species. A suckling female, shot on June 29th, is an interesting specimen as showing a peculiar phase of the molt. The long winter coat is considerably bleached on the upper parts and sides; and from the nose to a line drawn across the head just back of the ears, upon the anterior margin and extreme tip of the ears, and for a space upon each shoulder it is entirely replaced by the new growth of shorter yellowish rusty hairs annulated with black. The bright chestnut of the dorsal region, besides being very much worn, is interrupted just behind the shoulders, by an irregular patch of the new hair, in which the black predominates. The sides of the head and neck as far forward as the roots of the whiskers, the greater surface of the ears, a space on the back of the head, and the entire posterior portion of the body still retain the old pelage.—Wm. A. Shryock.

The Mammals of Thibet.—Several French travellers have explored China, Mongolia, Thibet and Indo-China, and their reports are full of interest. Every naturalist knows of the brilliant discoveries made 25 years ago by M. l'abbé Armand David; they were revalations of the richness of the Thibetan fauna. Since that time M. le Dr. Harmand, M. Pavie, M. Joseph Martin, le prince Henri d'Orleans and M. G. Bouvalot, M. Dutreuil de Rhins and the French missionaries of Tatsi-en-lou, directed by M-go Biet, have contributed much to our knowledge of the natural products of central and eastern Asia.

The collections made by le prince Henri d'Orleans have been referred to the Museum d'histoire naturelle. They comprise a large number of mammals and birds, the former of which forms the basis of a paper by M. Milne-Edwards. The birds have been studied by M. le Dr Oustalet.

The fauna of Turkestan is very distinct from that of the Thibet region. The Tian-Chan mountains of Chinese Turkestan are inhabited by large quadrupeds very different from those of Europe; they are wolves bears, deer (*Cervus xanthopygus* A. M.-Ed.), roebucks (*Cervus pygargus*). Tigers and panthers from the south of Asia are seen there frequently. In the sterile and sandy desert which extends from Korla to Lob-Nor the fauna offers different characteristics; gazelles are abundant there (*Gazella subgutturosa*). They are seen in small troupes in the middle of those plains covered with a scanty herbage, and Tamarisks, where the only trees are stunted and twisted poplars, and where the river Tarim is lost in a great swamp. The color of the skin of these quadrupeds harmonizes admirably with that of the sand. The foxes are light yellow (*Vulpes flavescens* Blan.); *Gerbillus psammophilus* is common and resembles that of the Sahara; a cat (*Felis shaviana*) resembles in color and markings *Felis margaritæ* of the deserts of the northern part of Africa. Wild camels are found in small herds.

On climbing the slopes of the Al-tyn-Tagh, other animals are found; *Ovis poli*, *Pseudovis burrhel*, *Pantholops hodgsonii*, *Gazella picticauda*, wild Yaks with large diverging horns, covered with dark brown hair, *Equus kiang*, and numerous rodents.

From the Tengri-Nor to Batang the fauna is stilll more varied. The mountains, covered with conifer forests and thickets of rhododendron, afford shelter to many mammals. Travellers report seeing a black monkey with a long tail, which, however, they could not get near; but they captured several rhesus Macaques, remarkable for their large size, their long thick fur, and short tails. These animals, when adult, are comparable in size to the large Cynocephali of Africa; they live in large troops, are seen even in the midst of snow, and hide themselves among the rocks. The natives treat them respectfully and often feed them. A young female, bought in May, 1890, at Kiam Tatie, was sent to Paris, and is now in the menagerie of the museum. Although kept in a warm room, it has not the thick long fur to which it owes its specific name of *Macacus vestitus*. Neither *M. thibetanus* nor the snub-nosed monkey, *Rhinopithecus roxellanæ*, have been seen from Batang to Tsienlou.

Panthers and Ounces are abundant, also *Lynx rufus*; *Felis scripta* is also found here, and another species with a large body, belonging to the same group as *F. chaus*, but differing from it, which I have named *F. bieti*; *F. tristis*, which attains considerably larger dimensions than it is generally accredited with; *F. manul*, remarkable for the black

tint on its chest, and belonging to a variety named by Hodgson, *F. nigripectus.* Wolves are common, and Cuons with long reddish brown hair, probably *C. duchunensis;* Foxes, Skunks and Martens (*Putorius davidianus* and *Martes flavigula*); large bears, one black with a yellow pectoral spot, the other, brown, shading to bright yellow, identical with the one described by Fr. Cuvier under the name, *Ursus collaris. Arctonyx obscurus* A. M.-Edw. and *Ailurus fulgens. Ailuropus melanoleucus* is unknown in this region.

The Glires are represented by *Pteromys alborufus,* numerous squirrels (*Sciurus erythrogaster* and *Sc. fernyi*), *Tamias maclellandi, Arctomys robustus,* different species of Mus, a Siphneus distinct from those already known (*S. tibetanus*), *Lepus hypsibius,* the feet of which are colored red by contact with the ferrugineous soil, two species of Lagomys (*L. koslowi* and *L. melanostomus* Büchner).

The ruminant species are numerous. Wild Yaks, *Ovis nahoura,* and a species with compressed horns, believed to be new; *Pantholops hodgsonii,* a large Nemorhedus with a body like *N. bubalinus* of India, but having a long mane of white hair, and related to the species *Nemorrhedus argyrobhœtus,* described by Père Hendes; two varieties of musk, Moschus, one gray-black in color, the other lighter, inclining toward yellow; *Elaphodus cephalophus,* the same species as that found in the valley of Moupin, but not quite so red; a roebuck similar to the one in the mountains Thian-Chan, but not so robust (*Capreolus pygargus*); a deer belonging to the group Rusa, but differing from the Sambur of India and Cochin China by its bushy tail which is longer and blacker, by larger ears, its muzzle bordered with black and its feet which are yellowish-white at their extremities.

It is astonishing that in such a short time the explorers could have collected such a large number of species. It is evident that fresh research in the same field will bring to light other mammals. Mgr. Biet, Bishop of Diana, and apostolic missionary of Thibet, has kindly given orders to have hunters sent in search of the animals along the upper Yang-tse-Kiang; but with these at hand, we see the resemblance between the animals of this part of Thibet and those of Indo-China, and we also note, at the same time, certain peculiar characters which are not found elsewhere. (Prof. A. Milne-Edwards in Proceeds. Cong. Internatl. de Zool, Deuxième Session à Moscow, 1892. Moscow, 1893.)

Zoological News.—ARACHNIDA.—In two papers,[5] Mr. George H. Carpenter enumerates five species of Pycnogonids brought back by

---

[5] Sci. Proceed. Roy. Dublin Socy., VII, 1892: VIII, 1893.

Prof. A. C. Haddon from Torres Straits. Of these, three (*Parapellene haddonii, Ascorhynchus tenuirostris* and *Rhopalorhynchus clavipes*) are new.

HEXAPODA.—The last number of the Kansas University Quarterly (Vol. II, No. 3, 1894) contains "New genera and species of Dolichopodidæ," by J. M. Aldrich, and "Descriptions of North American Trypetidæ," by W. A. Snow.

MOLLUSCA.—The molluscs collected during the United States Expedition to West Africa, in 1889–90, have been made the subject of a report by Mr. R. E. C. Stearns. In all there are 122 species, birds-it uted as follows: Pelecypods, 35; Marine Gasteropods, 69; Land Gasteropods, 82; Cephalopods, 5. (Proceeds. U. S. Natl. Mus. Vol. V, 1893.)

CHORDATA.—Balanoglossus has recently been found at Broken Bay and at Jervis Bay, New South Wales. The genus was previously unknown from Australia.

Prof. W. E. Ritter describes[6] a new Tornaria from California, the first indication of the existence of Balanoglossus on the Pacific coast of the United States. This Tornaria, like the Bahaman form, possesses tentacles on the longitudinai ciliated bands, and like the form described by Metschnikoff has a second circular band of cilia. In the oldest Balanoglossus obtained by the transformation of the Tornariæ, but two pairs of gill slits had appeared, and there is farther a thickened œsophageal band of epithelium which Professor Ritter would compare, in function at least, with the endostyle of Tunicates and Leptocardii. Lastly, the nerve cord does not arise by delamination but by a sinking down of the whole ectodermal nerve layer in a manner somewhat like that in Amphioxus. In the stages studied there was no trace of neuropore or neural canal.

An important collection of fresh water fishes from Borneo, examined by M. Leon Vaillant, extends the number of species now known from that Island to 322. M. Vaillant points out the strong resemblance of the fish fauna of Borneo to that of Indo-Malaysia. (Revue Sci., Feb., 1894.)

According to Mr. F. C. Test, the "Gopher Frog," *Rana aesopus* Cope, is subterranean in its habits, living in the burrows of the Gopher Turtle. It probably feeds on the insects living in the burrows, for these holes possess a flourishing insect fauna, to a great extent peculiar to them. (Science, 1893.)

[6] Zool. Anzeiger XVIII, 24, 4894.

EMBRYOLOGY.[1]

Experimental Embryology.—Two interesting pieces of work employing experimental methods have been recently published by Dr. T. H. Morgan. The first[2] appears to be but a preliminary account to be followed by more detailed illustration. The second[3] is complete and illustrated by figures drawn by the associated author Umé-Tsuda.

The former deals with the echinoderm—the latter with the frog-egg.

In the sea-urchin *Arbacia punctulata* minute fragments of the eggs may be fertilized and undergo cleavage, but there is no evidence that fragments develop unless they have part of the female pronucleus. Hence Boveri's experiments[4] upon the cleavage of e-nucleated fragments are to be regarded with doubt.

When the eggs are pressed, after the method of Driesch, there is evidence that the place of formation of the micromeres is pre-determined, and not localized by intersection of the actual first and second planes of cleavage since it may be where the first and third furrows cross.

A repetition of Loeb's experiments[5] shows that the action of an increased strength of sodium-chlorid in the sea water is to stop not only the external but also the internal or nuclear phenomena of cleavage, contrary to Loeb's notion.

In the starfish *Asterias forbesii* it seems that shaking the eggs hastens the maturity processes!

The most remarkable part of the paper is the evidence pointing strongly to the conclusion that the eggs of the above star-fish may be fertilized by the sperm of the above sea-urchin, "two animals belonging to entirely different 'Classes' of the animal kingdom"!

In the second paper the vexed questions of the orientation of the embryo, the place and manner of closure of the blastopore and the related idea of concrescence are approached not only from direct study of living eggs but from the examination by sections and surface views of eggs that have been injured by needle-thrusts or modified, retarded, in development by action of certain salt solutions. Many important details hitherto overlooked are made plain and some interest-

---

[1] Edited by E. A. Andrews, Baltimore Md: to whom communications may be addressed.

[2] Anatomische Anzeiger IX.

[3] Quart. Journal Mic. Sci., Jan., 1894.

[4] See American Naturalist, March, 1893.

[5] See American Naturalist, April, 1893.

ing, but unsuccessful, experiments recorded in addition to these of immediate value. The general result is that the blastopore begins to form below the equator of the egg, in the white region, and closes in by a peculiar overgrowth from the dorsal lip, so that we cannot speak of a real process of concrescence of two lateral areas. The embryo is, however, formed along this region, that is upon what was the lower white side of the egg.

Embryology of Cyclascornea.—Heinrich Stauffacher has recently (Jen. Zeit., II Heft, 1893, pp. 196–246) studied in considerable detail the development and segmentation of the ova in *Cyclas cornea* L., in which the ova are developed in a single pair of follicles, the sperm in several pairs. The follicle is a simple tube lined with columar epithelium, surrounded by a homogeneous membrane. The primitive ova first appear as small spherical or elliptical cells next the membrane, among the bases of the cells of the follicle. The nucleus occupies almost the whole cell and has its chromatin rather uniformly distributed in the form of granules. As the ovum grows, it projects into the cavity of the follicle beyond the surrounding cells, but remains attached to the membrane by a constantly narrowing stalk. The egg membrane is formed only over the free projecting portion; the point of the ovum by which it is last attached by the stalk, persists as the micropyle. The ovum grows in part by the absorption of the surrounding cells of the follicle. Two Centrosomes were found in the mature ovum.

Stauffacher's description of the earliest stages of segmentation does not differ widely from Ziegler's account (Zeit. Wiss. Zoöl., Vol. 41). The egg divides into a small primary micromere and a large macromere. The former divides into right and left secondary micromeres, the latter into a second primary micromere and a macromere. This process is repeated, new primary micromeres being formed from the same side of the macromere, so that in these early stages, the secondary micromeres are arranged as right and left rows lying on the macromere.

Bilateral symmetry is shown from the first. During the resting period after the formation of the first primary micromere, the protoplasm of the micromere with its nucleus, becomes arranged around its free periphery, leaving a considerable cavity in the micromere next the macromere. As the second, third and fourth primary micromeres are formed, a cavity is similarly found in each. It disappears from each as the next primary micromere is formed, and is not present after the fourth.

The true cleavage cavity appears in the 13-cell stage. In the 16-cell stage two mesenchyme cells were found lying in the cleavage cavity, near the macromere, and Stauffacher thinks they are derived from it.

At about the 30-cell stage the last primary micromere is formed. Ziegler thought it formed the two large primary mesoderm cells, but Stauffacher thinks it enters into the formation of the ectoderm along with all the previously formed micromeres.

The macromere next divides into equal right and left halves. From each of these a large cell is segmented off into the cleavage cavity, one slightly before the other, agreeing with Rabl's account for Unio. These two cells last formed are the primary mesoderm cells. The two small remaining macromeres form the endoderm.—C. P. SIGERFOOS.

ARCHEOLOGY AND ETHNOLOGY.

Progress of Field Work of the Department of American and Prehistoric Archeology of the University of Pennsylvania.—Further search for proof of Man's great antiquity in North America has led to an exploration, in November, 1893, of the chalk gorges in southern Texas, where rumor reported the discovery of human relics mixed with the bones of the Mammoth and Fossil Horse. But the alleged sites of artificial hornstone chips and of human interments examined in the San Diego gorge, (Duval County, Texas), belonged not to the fossil-bearing layers but to a talus, which, mingling modern surface loam with ancient underplaced chalk, has greatly obscured the record of the freshet-torn ravine.

Further negative evidence, again illustrating the difficulties to be encountered in the search for human relics in the ancient layers of these parched water courses, was found in the deeper gorge of Indian Creek, near Berclair, (Bee County, Texas), which, like that at San Diego, had in recent years furnished shelter and stagnant drinking water to roving Indian bands. Here artificial chips and fire-fractured stones falling from the loamy crest of a fossil-bearing bluff lay not far from the teeth of the extinct American Horse in an indiscriminate talus below, while the clear, water-eroded cuts, exposing for more than a mile the stratification, (chalk and pebbles, marl and sand 6 to 18 feet and surface loam 2 to 8 feet), showed no human relic in situ to prove that Man in southern Texas had ever been the contemporary of the Mammoth, the Broad-Horned Ox and the Fossil Horse.

Turning again to the record of caves for the traces of Man as a possible predecessor of the Indian and contemporary of an older fauna in the Eastern United States, the dry, well-lit and easily accessble Cavern of Lookout Mountain, on the left Tennessee River bank, below Chattanooga, was examined in December, 1893. Four trenches, 6 feet wide and 5 feet 10 inches to 3 feet deep, dug twice to rock bottom across its floor, proved that Man had lived there. But they surprised us by showing the absence of distinct layers of occupancy separated by crusts of stalagmite, clay, sand or breccia, marking lapses of time between his comings and goings. Here, where the cave's shelter must have been forced upon the notice of primitive people by the narrowness of the river path and the height of the overhanging cliff, but a single bed of refuse, homogeneous throughout and showing no evolu-

tion in the form, material or grade of relics discovered, rested on the cave earth and limestone. No trace of "Paleolithic Man" or "Mound Builder," "Pigmy" or "Welshman" underlaid the familiar black band 3 feet 8 inches at thickest, that betrayed the well-known maker of shell-mixed pottery, bone awls, chert arrowheads, shell beads, drilled sandstone and clay pipes. The Indian, as known to the white discoverer, bringing with him a neolithic culture learned elsewhere, coming as high in the scale as he departed, and who had, as I found, laid the bones of his dead upon inner ledges of the cave and cast them dried and clean with arrowheads, potsherds, and broken perforated gorgets upon mortuary fires in a subterranean chasm 250 paces from the entrance, had alone inhabited the cave.

Paleontology would assert no antiquity for his occupancy as judged by the 29 living and 2 extinct species of fauna found with the refuse Some animals, traced by their bones in the fire places, like the Spade-Footed Toad, the Bat and the Tortoise, though the contemporaries or successors of the cave inhabitant, may have found their way into the midden heap to die, while the remains of the Unio, (7 species), Io, (2 species), Trypanostoma and Paludina, (2 species), and of the Catfish, Sucker, Drumfish, Land Tortoise, Water Tortoise, Soft-Shelled Turtle, Wild Turkey, Marmot, Lynx, Opossum, Squirrel, Raccoon, Otter and Deer, sometimes split and scorched, generally disassociated with teeth and but once showing traces of rodent gnawing, inferred the hunter's capture of food in river and forest and his carrying of larger animal trunks decapitated to the cave feast.

A bone of the extinct Peccary lying in the refuse repeated the discovery made in Queen Esther's chamber of Durham Cave, Pennsylvania. But the teeth of the Tapir (*Tapirus haysii*), and the lower ramus of an extinct Edentate of the family of Megatheriidæ kindly identified with all the other bones by Professor Cope, found by us in Section 5 (3rd foot) and close to the bottom of the layer of occupancy, added a new species and another genus to the list of (northwardly) extinct American mammals thus far observed in like association with human remains. Still we had not positively found that the Indian had met this gentle South American herbivore and an animal like the giant sloths Megalonyx or Mylodon, in the mountainous region of the upper Tennessee, for 1 foot 9 inches of the original red cave earth remained undisturbed and free from bones when examined, under the human refuse. The Tapir teeth and edentate jaw lying where found, near the bottom of the refuse and close to this lower stratum, may have been imbedded in the latter before the Indian came, so that if he

PLATE VIII.

Alca impennis L.

From The Dictionary of Birds.

encountered them in scratching his wonted oven hole he might have mixed them with what was to grow by degrees into the present fire-blackened layer.

The awe-inspiring entrance of the Nickajack Cave, (left bank of the Tennessee River, Marion County, Tennessee), though subject to partial invasion by river freshets that back the water of the cave creek several hundred yards into its channel, showed traces of aboriginal habitation as far as light penetrated. But the human refuse lay in a scattered talus on an uneven and craggy floor, about 250 feet wide, which, sloping steeply into the cave stream, was buried under masses of leached earth thrown upon it by nitre diggers in 1863–64. Where the remains of old fires were caught in hollows in the slanting ledge underlying this nitrous deposit, a trench (12 feet 10 inches long by 6 feet wide, by 2 feet 10 to 3 feet 5 inches deep), revealed again a single homogeneous layer of human occupancy continued on an undisturbed shelf clear of the nitre heaps and containing the remains of Unio (5 species), Paludina, Trypanostoma, fresh water Drumfish and Deer, and with its bone awls, arrowheads, chips, hammerstones and pottery repeating the record of the Lookout Cave. Again all trace of more ancient human presence betokened by underplaced deposits was wanting. Earlier peoples, if they existed, had avoided the Nickajack Cavern, and it is only pre-Columbian inhabitant had been the Neolithic Indian, who, strewing the alluvial meadows at its mouth with arrowheads and hornstone chips, had left potsherds, pebble hammers and a perforated ceremonial stone, along with the remains of the cave midden Mollusca and the Deer, Tortoise and Rabbit, at the river-side shell heaps a mile away.

Throughout the above investigation we have owed a grateful acknowledgement to the suggestion and kind encouragement and assistance of Professor Cope.—H. C. MERCER.

The Trenton Gravel Discussion has thrown light upon Man's antiquity in North America, but has not settled it.

We know that geologically, modern Indians chipped the rude leaf shaped outlines which we may as well call "Turtlebacks," but we do not yet know who else made them. The "Turtleback" exists without the Indian in Europe, and the more we study it the less—unhelped by associated evidence—we care to call it "Paleolith" or "Implement" on the one hand, or "Reject" "Unfinished Implement" or "Failure" on the other.

It was the quarry "Turtleback" of the pot making stone polishing Indian, that first fairly roused attention, and troubled us with the fear lest the Trenton "Turtlebacks" resembling it, had slipped down into the glacial gravels.

Some of the quarry "Turtlebacks" (viz., the spade like outlines from Garland Co., Arkansas), were big. Some (as the ½ inch long specimens from Macungie, Pa., and Flint Ridge, Ohio), were little. Some were made of pebbles (Piney Branch), some of native rock, some of Jasper, some (Gaddis' Run) of argillite, some were tolerably thinned before they left the quarry (Piney Branch and Flint Ridge). Others (Gaddis' Run) were not, some were leaf shaped, some rather triangular, others discoidal.

Still there was a family resemblance, and it seemed after examining thirteen American quarries east of the Rocky Mountains, that certain universal laws for blade chipping in the stone age had been discovered, for instance, that as the Indian quarrymen were yet Indians though they left no "Indian Relics" at the diggings, so the Drift Man (if he existed), though he left nothing but "Turtlebacks" in the Drift, might really have been a stone polisher and potter after all.

But to find arrowheads close by the pits at Flint Ridge, Macungie, and Saucon Creek, pitted hammerstones at Gaddis' Run, polished stone tools at Durham, and pointed wooden billets at Macungie, limited the ground for such inference, and as we may hope to find a rotting fuse or rusty iron drill under a heap of belgian blocks at a modern quarry, so there seems a chance of finding polished stone tools, arrowheads and pottery in the Drift, if the Drift Man made such things.

The fact that the Indians had quarried the stone, blocked it out into blade forms, rejected some of these, worked others into oft buried "blanks" and specialized the latter into spears and knives, seemed at first to indicate that an implement to be finished, and therefore to fairly represent the culture of its maker ought to be specialized. But the rule would not work always. The "Turtleback" was not the neglected brother of all chipped stone tools. What at Fort Bridger, Dakota, (as seen by Dr. Leidy in 1870) were serviceable implements (Teshoas) chipped by Indians from pebbles at a single blow, were at Washington quarry refuse chips. The flakes that were rubbish at Macungie and Flint Ridge, were hoarded together and carefully buried in Florida Mounds. If we went abroad we found in the Easter Island, knives, Admiralty Island, spears and Australian gum-mounted splinters, implements which were finished but yet unspecialized; and Mr. Ernest Volk showed us that "Turtleback" labelling might go wrong

at the very heart of the question where the ground seemed surest, when he found two hoards of rough argillite "Turtlebacks" which by all quarry experience ought to have been "rejects."

A whole new class of pros and cons were introduced into the study when we discovered in June at the argillite outcrop and indian blade quarry in the Delaware Valley, 20 miles above the hunting ground for the Trenton Turtlebacks; that there were two classes of Indian Turtlebacks—those of the quarry and those of the river-side. The evidence of these latter river-side specimens made from surface material, and that of Jasper pebbles found flaked by Indians at sea shore camp sites in New Jersey and Maryland, suggested strongly that "quarries" were comparatively modern and that rules of stone chipping derived therefrom would not cover the whole ground.

It seemed that the Indian must have been for a time a chipper of erratic stones on river beaches before the status of culture involved by quarries was reached, and that "Turtleback" work shops of what might be called a pre-quarry age, probably existed in the United States older than Flint Ridge, Durham, Gaddis' Run and Piney Branch, whose products remained to be compared with the alleged work in argillite of the Drift Man.

It was important to note that of the recorded argillite Trenton specimens, 29 were of this Delaware Indian "river-side" type, but against the case that one (Peabody Museum, No. 33,168, labelled as found 9 feet below the surface in the Penna. R. R. cut) had the stamp of the Gaddis' Run Indian quarry strongly upon it.—H. C. MERCER.

MICROSCOPY.[1]

Orienting Small Objects for Sectioning, and "Fixing" them, when Mounted in Cells.

I. In one of the recent "Contributions from the Zoological Laboratory of the Museum of Comp. Zoology," Vol. XXV, No. 3, Dr. W. McM. Woodworth describes a method of orienting small objects for the microtome. His method was developed, he states, from one first used by myself. To avoid any misunderstanding, I will say that in answer to a letter from my friend Dr. Woodworth, asking permission to use or describe my method, I replied that he was at liberty to make what use of it he saw fit, or words to that effect. I refer to the subject here, partly because Dr. Woodworth does not state what the original method was, or how he has modified or added to it, but mainly because I believe the original method is much simpler and better adapted to the purpose than his.

My method, which is especially useful when one desires to orient accurately large numbers of small and similar objects, is as follows:

Small strips of glazed writing paper marked with two sets of raised parallel lines running at right angles to each other are cut, and at suitable intervals a very small drop of thick collodion and clove oil, about the consistency of thick honey, is added. The drops are arranged close together along one of the ribs that run lengthwise of the paper. The object to be imbedded is cleared in clove oil, or oil of bergamot—not turpentine. The latter dries too quickly, so that air bubbles are likely to form in the object; and besides it does not mix readily, as it should, with the thick collodion. It is then raised on the point of a knife, and after the excess of oil is drawn off, transferred to a drop of the thick collodion. It may then be adjusted at leisure under the compound or the dissecting microscope, and will stay in any desired position.

When half a dozen or more objects are oriented in reference to the cross lines (which are to be parallel to the section planes) the whole thing is placed in turpentine. This washes out the clove oil and fixes the objects very firmly to the paper. When submerged in turpentine, if desirable, the relation of each object to the orienting lines can be redetermined under the compound microscope with greater precision than before. If any one of them has been inaccurately placed, it may still be moved to some extent, but it is better to note the fact, and

---

[1] Edited by C. O. Whitman, Chicago University.

make the necessary deviations from the section lines when that particular object is sectioned.

The paper with the attached objects is now placed in the paraffine bath, and finally removed and covered with paraffine in the usual way. After cooling in water, the block is trimmed and the softened paper peeled off, leaving the objects in the paraffine, close to the under surface of the block. This surface is now marked by the orienting lines of the ribbed paper and also by the record numbers, which, before imbedding, were written with a soft pencil on the paper. The block is now fixed in the microtome, and the objects cut one after the other, as though a single object had been imbedded; or a number of them may be cut together, if they have been arranged with that object in view. For example, we may use a thinner collodion, and arrange a large number of insect embryos, or small worms in a compact bundle, like a package of cigarettes, and cut them all at once.

Although I have not tried Dr. Woodworth's method, it seems to me that he has merely added to what is described above, several complications, which might in most cases be omitted. He gums the paper to a glass slide, dries it, covers the exposed surface first with a layer of gum and then with a collodion film, each of which must dry separately. The objects cleared in turpentine are then placed in position in the film which is softened and rendered adhesive by exposure to ether vapor, then slide and all are placed in the paraffine bath. Finally after imbedding, the slide is soaked in water to free it from the paper and the paper from the paraffine. In most cases I find it quite unnecessary to gum the paper, as it comes away from the collodion and the paraffine very well without it. It is, moreover, very inconvenient and unnecessary to imbed the paper attached to a glass slide in the paraffine bath. The paper alone can be handled with perfect ease, and it does not curl up or warp in the bath. If any warping occurs, I should say it was due, for obvious reasons, to the use of a collodion film in place of minute drops of collodion and clove oil. I should suppose also that any object of considerable size, say the egg of Limulus, could not be easily fixed in the manner suggested by Dr. Woodworth, for it is merely the adhesiveness of the small amount of turpentine on the object which must be depended upon to hold it in place. But as the turpentine evaporates rapidly, this would tend to free the object, or else fill it with air bubbles before the requisite number could be oriented, preparatory to softening the collodion in the ether vapor.

The advantages of the method, as I use it, are many; ease, rapidity (although we need not hurry) and accuracy of orientation; time saved

in imbedding and sectioning a considerable number of objects as one; and above all when many objects much alike are to be imbedded, there is no danger of confusion, since each one is plainly marked with its appropriate number.

* * * * * * * * * * * *

II. As every one knows, it is a great nuisance to mount under one cover, a large number of objects that tend to roll about into undesirable positions. It is often necessary to mount each one separately and then roll it about at great risk, till it is is just where we want it. And after all it is impossible to roll some things into place. I have used a modification of the method described above in mounting large numbers of objects under one cover, in perfect order, and in any desired position.

In mounting the eggs of Limulus, or heads of insect embryos, etc., I construct a cell of the requisite dimensions, and place in it small drops, close together in rows, of the thick collodion and clove oil. An egg is taken out of the clove oil, drained, and placed in a drop of collodion in the desired position. A great many eggs may thus be arranged like serial sections under one cover glass. Before adding the balsam, the slide is immersed in turpentine, which serves to wash away the clove oil and leave the eggs firmly fixed in the collodion.

The only precaution necessary is not to use too much collodion. It is surprising to find the small amount necessary, and the firmness with which the objects are held by it in place.

I have recently used, with a class of beginners, the above method of imbedding, with satisfactory results—merely as a matter of convenience in manipulating small objects easily soiled or broken in handling. Any glazed paper, or glazed tracing cloth will do, provided the collodion and clove oil is thick enough. The raised ribs may be replaced by fine black lines drawn with a soft pencil. These lines like the numbers are transferred to the paraffine when the paper is removed.

WILLIAM PATTEN, Hanover, N. H.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island.—January 13.—The Secretary read an invitation to attend the funeral of the Rev. Samuel Lockwood, of Freehold, N. J. Also the following extract from a communication by Mr. Ira K. Morris, which was adopted as the sentiment of the meeting, ordered spread upon the minutes and a copy transmitted to the family of the deceased:

It is with profound sorrow that we learn of the death of Professor Samuel Lockwood, of Freehold, N. J., on Tuesday last. By this sad event our Association has lost a very warm friend, and we shall feel most keenly the absence of his kindly encouragement and intelligent criticism. For years past he has taken a deep interest in all our proceedings.

Mr. Wm. T. Davis exhibited specimens of and read the following paper on Staten Island Harvest Flies.

Dr. Harris, writing of harvest flies, or locusts, in his "Insects Injurious to Vegetation," says of *Cicada canicularis* Harris:

"During many years in succession, with only one or two exceptions, I have heard this insect on the 25th of July for the first time in the season, drumming in the trees, on some part of the day between the hours of ten in the morning and two in the afternoon. It is true that all do not muster on the same day; for at first they are few in number, and scattered at great distances from each other; new-comers, however, are added from day to day, till in a short time, almost every tree seems to have its musician, and the rolling of their drums may be heard in every direction."

This *Cicada* is much less common on Staten Island than in Massachusetts, where Dr. Harris heard it sing so regularly on the 25th of July. It is plentiful, however, up the Hudson River, in northern New Jersey and in parts of Pennsylvania. On our Island its place is taken in point of numbers, by *Cicada tibicen* L., (*C. pruinosa* Say), a larger insect with a much more impetuous song. The species first appears about the second week of July, and I have recorded its song in the past as follows:

July 15, 1879, July 17, 1885, July 12, 1887, July 14, 1888, (three individuals), July 9, 1889, July 9, 1890, July 11, 1891, July 11, 1892.

Cicada tibicen L., also sings after dark on warm nights, but it is a lazy, languid song, as if the insect were tired, and it totally lacks the

impetuous vigor of the noon-day outburst. In the warm nights during the first part of August, 1887, it was no uncommon occurrence for this insect to give a short *z-ing.* Up to 8 p. m., they often sing, and I have heard a *Cicada* and a katy-did in adjoining trees. On Aug. 17, 1888, long after the sun was down, they kept up their songs, each one desiring apparently, to be the last singer, for their voices are raised in envy and the males have no love for one another. They often sing while flying about a tree in wavy lines, and once I detected another *Cicada* fly out of a tree and join the singer. It was no doubt a female.

They continue musical as late as the end of September, occasionally in considerable numbers I have heard them as late as October 3rd, both in 1885 and 1886. In the first mentioned year, they were exceedingly plentiful. When singing loudly the abdomen vibrates quite fast, but gradually lessens as the song subsides.

The dry pupa shells of this insect may be found attached to the bark of a variety of isolated trees, upon the roots of which the larvæ have apparently fed. On the 26th of July, 1889, at eighteen minutes to 5 p. m., I saw a harvest fly come from its pupa case. The legs (tarsi excepted) the prothorax and folded wings, were of a grass green color, the wings being particularly bright. The eyes were also green, the ocelli golden and the mesothorax and abdomen of a brassy appearance. In twenty minutes the wings were of full size, but flimsy, bending with the breeze. The wings were held out flat, on the same plane with the dorsal surface, when drying, and the genitalia are protruded.

The third and largest species of *Cicada* that has been found on the Island is *C. marginata* Say. The wings of a specimen, spread in the usual way, expand nearly five inches. This insect has also been taken at Yaphank, on Long Island, by Mr. A.C. Weeks; and Mr. Wm. H. Ashmead, who kindly examined my *Cicadas*, says that the insect occurs in Pennsylvania and about Washington. On our Island but one specimen has been found. It was discovered on a small post oak on a sand dune, near Mariners' Harbor, on July 19, 1892, while Mr. Beutenmuller and I were looking for galls. It was late in the afternoon and the insect had evidently but a short time before emerged from the pupa-case, which we found at the base of the tree. In the same summer a second pupa-shell was found on a black-jack oak, growing in dry sandy ground at Watchogue.

The only other harvest fly that has been collected on the Island is the red eyed periodical *Cicada*, or "Seventeen year Locust," of which a more detailed account, in connection with this locality, will be given at some future meeting.

Mr. Thos. Craig read a paper on A New Dictyosphærium.

In Wolle's description of this genus he describes the cells as green, and egg or kidney shaped, united in a globose hollow family, involved in a gelatinous integument.

He describes four species: *D. ehrenbergianum* Naeg., *D. pulchellum* Wood, *D. reniforme* Bulnh., and *D. hitchcockii* Wolle. The one under consideration does not agree in description with any of the above species. It was found along with other algae, tangled in the roots of water cress in a pond in the woods back of the Moravian Cemetery.

Mr. Walter C. Kerr exhibited a carefully prepared drawing of the trunk of a red maple tree and read a paper on Aerial Roots on *Acer rubrum, L.*

Near the brook flowing from Logan's spring swamp east of Silver Lake stands a red maple, about fourteen inches in diameter, and on its north side the bark has been stripped, probably by splitting from a wound received while young, forming a bare triangular space extending nearly across the base of the tree and having its apex thirty-six inches from the ground. The wounded bark has healed and its edges are covered with a smooth, gray, corky layer presenting the rounded appearance common to the edges of such scars. The wood being uninjured remains in a good state of preservation, while the entire tree is in vigorous growth.

It stands on a slight rise, about twenty-five feet south of the creek, in rich, rocky, moist ground, within eight feet of a low spot, which, though swampy in the wet seasons, is never overflowed.

The nearest trees are white oak and hop hornbeam, nine and fifteen feet distant, with no others within forty to fifty feet. Undergrowth is absent, and there is no reason to suppose that earth or stones have ever been heaped about it. It branches twenty feet from the ground and thus there are no conditions of darkness or exceptional moisture to encourage the development of aerial roots.

About six inches below and to the right of the apex of the triangular wound there springs from the cambium of the healed bark two roots, each one-half inch in diameter. They extend downward across the scar at an angle of about forty-five degrees; the upper being twelve inches and the lower seventeen inches long. They have decided root form and are covered with rootlets, the upper bearing about twenty and the lower about fifty.

The development of rootlets proceeds almost wholly from the lower surface of the roots, their length being from two to twelve inches, many being about six inches long, and all profusely branched, while

from the upper surface only a few stunted rootlets rise, sparsely branched. The whole appearance of these roots presents a strong contrast to the branches or young shoots of the red maple, leaving no doubt as to their character. Their tendency toward the earth is marked, though not reaching it by some eighteen inches.

What should cause these aerial roots is by no means evident, unless the scar has at some time been covered with a loose layer of bark under which the roots have grown. They serve no purpose and it would seem as though they could scarcely survive. As they are now alive, it seems best not to molest them for the purpose of determing their exact character and mode of growth until after further development has been observed.

Mr. Arthur Hollick presented specimens of fossil leaves from Arrochar.

Mr. L. P. Gratacap remarked upon a series of lower Helderberg and Hudson fossils, found in drift bowlders by Mr. Hollick at Arrochar. They included finely preserved specimens of *Spirifera perlamellosa* Hall; *Strophodonta beckii* Hall; *S. woolworthiana* Hall; *Strophomena rhomboidalis* Wahl.; *Cœlospira concava* Hall, and *Leptæna sericea* Sowerby, besides fragmentary remains of a *Pterinea* and bryozoöns.

Boston Society of Natural History.—February 7th.—The following paper was read: Prof. Edward B. Poulton: Theories of Evolution. A discussion upon the subject of Professor Poulton's paper followed.

February 21.—The following papers were read: Professor Charles R. Cross: Physics of color mixture, with experiments; Professor E. S. Morse: A recent advance in color printing by a photo-mechanical process.

SAMUEL HENSHAW, *Secretary*.

New York Academy of Sciences, Biological Section, Feb. 12.—The following papers were read: 1. "The Morphology and Significance of the Variations of the Biceps flexor cubiti," by Professor Geo. S. Huntington. 2. "Our Conception of a 'Species' as modified by the Theory of Evolution," by Professor N. L. Britton. 3. "Reversal of Cleavage in a Sinistral Gasteropod," by Mr. H. E. Crampton, Jr. 4. "On the History of the Archoplasm in the Spermatogenesis and Fertilization of Lumbricus," by Mr. Gary N. Calkins.

BASHFORD DEAN, *Rec. Sec.*

The Biological Society of Washington.—Feb. 10.—The following communications were read: Dr. C. Hart Merriam, A Remarkable New Rabbit from Mexico; Dr. C. W. Stiles, A Parasite of Man New to the American Fauna.

February 24.—The following communications were read: Mr. M. B. Waite, The Structure and Method of Opening of the Anthers of the Pomeæ; Mr. B. T. Galloway, The Winter Coloration of Evergreen Leaves; Mr. L. O. Howard, Further Notes on Spider Bites.

FREDERIC A. LUCAS, *Secretary.*

SCIENTIFIC NEWS.

From the Annual Report of the Essex Institute for 1893, we learn the following facts. The library has increased during the year by the addition of 3,317 volumes, 8,348 serials, and 7,416 pamphlets. These include the library of the late Dr. Henry Wheatland and the foreign exchanges of the Peabody Academy of Science, the libraries of the two institutions being now united. The total investments of the Institute now amount to $100,188.44, and the membership amounts to 325.

Giovanni Passerini, Professor of Botany in the University of Parma and well known for his studies on Aphides, died April 17, 1893.

Francis P. Pascoe, an English Coleopterist, died at Brighton, England, June 20, 1893, in his 80th year.

Dr. Robert Ritter von Schaub, who has studied the anatomy of the Mites, died in Vienna, Oct. 21, 1893.

Dr. A. K. Edward Baldamus, the ornithologist, died in Wolfenbüttel, Brunswick, Oct. 30, 1893, aged 81.

Robert Bentley, the botanist, died January, 1894. He was born at Hitchin, Herts, March 25, 1821. For many years he was professor of botany in the London Institution and examiner in botany to the Royal College of Veterinary Surgeons of England; lecturer on botany at at the medical colleges of the London, Middlesex and St. Mary's

Hospitals, and for twenty years dean of the medical faculty in King's College, London. For ten years he was one of the editors of the Pharmaceutical Journal. He wrote a "Manual of Botany," which has reached the fifth edition. He was the author of a series of manuals of elementary science, also "Student's Guide to Structural, Morphological and Physiological Botany." And was the joint author with Dr. Trimen, of a four-volume illustrated work on "Medicinal Plants."

Mr. E. B. Poulton, who has recently been lecturing in various cities of the United States, has been elected Hope Professor of Entomology in the University of Oxford, as successor to the late John Obadiah Westwood.

The summer school of Cornell University announces courses in Physical Geography, Geology and Economic Geology, by Professor R. S. Tarr.

The following appointments have been made at Cornell University. here. Mr. G. D. Harris, Assist. Professor of Paleontology and Dr. A. C. Gill, Assist. Professor of Mineralogy and Petrography.

THE

AMERICAN NATURALIST

VOL. XXVIII. May, 1894. 329

REMARKS ON SCHULZE'S SYSTEM OF DESCRIPTIVE TERMS.[1]

BY ALPHEUS HYATT.

One cannot systematically describe a number of species or in fact properly record observations especially upon isolated species or groups without the aid of a convenient nomenclature and a generalized, topical scheme of work. The invention of such a system obliges one to make a more or less complete classification of the parts of any form, and this is a most efficient aid to thorough observation and a check upon hasty, inconsequent or unsystematic description.

Such remarks are apparently superfluous and even supercilious, but no one can work with new methods or try to find in scientific literature reliable data with regard to any of the invertebrates without being continually confronted with positive evidence that in the effort to place new species on record, many naturalists have lost sight of the main aim of descriptive work. The fixed habit of considering a new species as a discovery of such importance, that the describer's name must forever remain attached to it, is perhaps necessary, but it has loaded scientific research with an enormous mass of badly constructed records.

---

[1] This paper with the exception of the introductory remarks was published in Biologisches Centralblatt, XIII, Nos. 15-16, August, 1893, as Bemerkungen zu Schulze's System einer deskriptiven Terminologie. It has been thought advisable to have it published in English.

One of the most remarkable characteristics of the literature of this century in zoölogy and paleontology is the great contrast between the careless, inadequate, descriptive text of many large costly works and the excellent plates and other accompanying illustrations. There are a number of these books in which there is a wide difference between the scientific record made by the author and his artistic efforts or those of his draughtsman, the former being often inconsequent and unworthy of companionship with the latter. I refrain from giving examples for the simple reason, that they are within the experience of every student, and there would be no compensating advantage in exciting useless antagonisms. An attempt to construct a properly systematized topical scheme of work would have forced such authors to name and describe most of the principal regions and parts of the anatomy and to follow out a similar scheme in the description of each species, thus minimizing the irregularity and vexatious incompleteness of their observations.

One of the marked characteristics of the day in natural science is the effort to give greater accuracy to descriptive nomenclature. Professor B. G. Wilder[2] was the pioneer in America, and although his efforts were for many years unappreciated, they are now beginning to bear fruit. Wilder and Gage's Anatomical Technology (1882) laid the foundation of the movement which has just been reinforced in Germany by a very able paper from Franz Eilhard Schulze[3] in which he lays down some general principles for the construction of terms that ought to be carefully read by every naturalist.

The details of his scheme are in brief as follows:

He divides organic bodies into; (I) die Synstigmen, Centrostigma of Haeckel (στιγμα meaning point) having a single imaginary centre to the body. This point he proposes to call "centrum," parts in the centre "centran," approximate parts are "central" or "proximal," those which lie toward the cen-

---

[2] A partial revision of anatomical nomenclature, with especial reference to that of the brain. Science, II, 1881, pp. 122–126. 133–138.

[3] Bezeichn. d. Lage u. Richtung im. Thierkörper. Biol. Centralb., XIII, No. 1, 1893.

tre " centrad " or " proximad, " those lying away from the centre " distal " or " distad, " parts external or on the periphery " distan. " Any part at right angles to the imaginary radii of the body or to the surface, he proposes to call " tangential " as long as they are external or " paratangential, " when they are internal. Thus there may be tangential parts or distan, distal, proximal and central, paratangential parts, and they may be distal from the centrum or proximal when not central or centran.

Professor Simon Gage of Cornell in a letter to Dr. Wilder comments upon the use of " centran " as follows. " One of Schulze's principal points over what is ordinarily given is the suggestion of the termination " an " for the absolute centre, ventral surface, dorsal surface or aspect, etc. Barclay in his book, pp. 168–173, considers this and uses for this purpose the ending " en " as " centren, dorsen, dextren, sinistren, " etc.

" The natural development of these ideas would have been to make a distinction between internal and external, using the termination " an " for internal parts which are centran or axian and leaving " en " for the designation of such as are peripheral. It is, however, evident as suggested by Dr. Wilder, that the termination " en " is more suitable for the designation of internal parts, on account of its derivation and common use, whereas " an " is in line with the terminations " al, " "ad" and not in conflict with usage. It seems to me that Schulze is not wholly consistent in his use of the termination " an, " and that following Wilder's suggestion, it would be much better to say centren and use centran for any external points which might be established in the polar axis of the body."

The class of bodies referred to as Synstigmen are to be found exclusively among Protozoa or their corresponding cellular elements among Metazoa, and Schulze's term is defective in that it takes no notice of the large numbers, especially among Infusoria, which have a spiriform arrangement of parts or of the entire body, often also more or less complicated with bilateral asymmetry.

Although it is obviously desirable that the assumption of an imaginary centre should be made in cases which have no

organic centrum, it will be considered questionable in the description of tissue cells or the bodies of the Protozoa, whether the nucleus should not be considered as the centrum. Schulze thinks that in such cases a distinction should be made and an additional compound term framed which would express the difference between the artificial and natural points or axis, etc. Thus the nucleus would be the "nucleo-centrum" however excentric its position. Undoubtedly in this, as in other cases, it is of advantage to make comparisons between the imaginary morphic centre and the organic centre, since while these are often the same they are not coincident in many forms and the use of a double set of terms will oblige observers to note such phenomena in their descriptions. Nevertheless one cannot say without experience in practical application whether a double set of terms would be advantageous or merely burdensome. (2). Die Syngrammen (γεαμμη meaning line) the Centraxonia of Haeckel, bodies elliptical cylindrical, etc., pyramidal, etc., which may be considered as having their parts arranged around an imaginary central axis but having all sides equal. This axis he calls "principal axis" both ends are styled "termini," the surfaces immediately around the termini are "terminan" and the direction toward them "terminad."

Centrum, centran, centrad, are used as before for parts lying in the principal axis or in that direction. "Axian" is employed for parts in the principal axis, when near to that line "proximal,"[4] when directed toward it "axiad," the region away from the principal axis is "distal," the direction is "distad" and the surface or periphery is "distan."

All planes or parts lying in planes going through the principal axis are "meridian," all parallel with these "parameridian." The parts lying in the plane passing through the centre at right angles to the principal axis are "transversan," and

---

[4] The use by Schulze of "proximal" as a synonym for "central" is open to serious objection. Proximal, proximad as synonyms of central, centrad, are not essential to his scheme, and these words are already in use as general descriptive terms applicable to any neighboring parts. It is, therefore, obviously disadvantageous to try to give them a more restricted meaning. The restriction of distal, distad, distans, to the body has similar objections and is not sustained by usage.

the planes parallel to this are "paratransversan." If the suggestion were adopted, all parts lying internally in these planes would be meridien and transversen, and the points on the periphery also in these planes would be meridian and transversan.

He intimates that there are oral and "aboral" planes in the paratransversan planes, but does not advocate the use of the terms oran, orad, and aboran and aborad as desirable for those bodies having the mouth in what may be called the terminan paratransversan plane, and the anus or base in the opposite plane.

Among Porifera one can assume a central axis, and it is possible to distinguish the oral and aboral ends or what may be considered as corresponding to them, the excurrent apertures (or so-called oral openings) and the attached base. But the incurrent apertures, the digestive sacs, the tissues and the spicules of the skeleton are normally arranged in concentric layers, which cannot be referred to any system of imaginary planes parallel with the principal axis. There is in these forms no organic element by which a meridian plane can be determined, they are exclusively concentric.

The same remarks apply also to the Hydrozoa and Actinozoa and more or less to all of the animals included under the old term, Radiata, whose parts are normally arranged in concentric layers cut by radiating lines and planes. If Schulze's system had taken note of such general morphic characters it would have been more complete. The meridian plane can be organically determined in most of these organisms, but this primitive division of the body is not carried out in the structures of the sides, these have no organic lateral parts which can be advantageously compared with any supposed parameridian planes. They and the tissues of the body all lie in concentric tubular conical or spherical surfaces secondarily intersected by radiating lines and planes. Schulze's system of planes takes no notice of these facts, but his meridian and transversan planes can be used with advantage to indicate the existing bilateral elements in these structures. The main objection to his system appears to be that it is better fitted for use among

"Bilaterien," that is for Mollusca, Worms, Myriapods, Insects and especially Vertebrates, than for the simpler organisms Protozoa, Porifera, Hydrozoa, Actinozoa, in which this element of symmetry is absent or more or less obscured.

Professor Wilder has already used "peripherad" as the antithesis of "centrad" and according to Schulze's system peripheran could be used for the distan surface in general. Thus the mesenteries of the actinozoa extend peripherad from the principal axis or the median plane.

It is also questionable whether a good topical classification of such animals as Actinozoa and Echinodermata ought not to recognize an intermediate region between the central and distal regions. There would be just as great a difficulty in defining a central region and a distal or peripheral one as in limiting the use of these terms to two regions separated by a third, which might be termed the extra-central with reference to the axis or extra-median when used with reference to the corresponding plane.

(3). "Die Sympeden oder Bilaterien," Zeugiten oder Centrepipden of Haeckel. These bilateral bodies have three axis. The "perlateral" axis is described as "isopolar" by Schulze, probably in allusion to the organic similarities of its poles. "Equiradial" would be equally good description on account of the equal lengths of the radii of the axis. The other is the dorso-ventral axis and is what he calls "heteropolar" and this is apt to be also inequiradial. The principal axis is the longitudinal axis, also described as "heteropolar" and apt to be also inequiradial, estimating from the supposed organic centrum. All in the principal axis is "axian," the neighborhood is "axial," the direction "axiad," or one may also use proximal, proximad, farther from it everything is "distal," and the direction away from this axis is "distad."

The two ends of the principal axis are respectively "rostral" instead of "cephalic" or "oral" or "proral" (Prora, prow of a vessel) and the tail end or the other end, whether distinguished by a tail or not, "caudal" instead of "aboral."[5]

---

[5] Schulze subsequently gave his nomenclature with illustrative figures in Verhandl. d. Anat. Gesellsch., May 1893, and Verhandl. d. deutsch. Zool. Gesellsch., May 1893. In this paper and in the discussion following this last a

The surface of the rostral end is "rostran" and the surface of the caudal end is "caudan." The direction toward these are respectively "rostrad" and "caudad."

In a letter from Prof. Gage to Dr. Wilder which has been forwarded to me, the former very justly observes that "Schulze discards 'cephalic' although he adopts caudal. Cephalic is certainly a more natural opposite of caudal than is rostral, the word he proposes in its place. Then cephalic has been and is used a great deal in English and considerably in German, and the use is increasing."

The main objection to this in my opinion, is that it applies to the vertebrata better than any other type and fails with the simplest forms of these. Among Ascidia, for example, there is perhaps a rostral extremity, but there is no caudal extremity in the adults. There is an aboral region, but the oral region is central or centran. While one therefore might make rostral, rostran and rostrad work well, some other term than caudal should be employed for the opposite pole. It seems contrary to all rational usage to employ terms having a definite meaning like cephalic and caudal to bodies that have no head, nor representative oral opening, and no tail.

Whenever in bilateral animals the mouth is at the extreme pole of the principal axis, I can see no objection to the use of oral, oran, orad, but when it is not there rostran, rostral and rostrad are highly appropriate. When the mouth is external and ventran, or lies out of the principal axis on any surface, as it is in a number of types, additional accuracy may possibly be given to the terminology if both rostral and oral planes or regions were recognized. At any rate this suggestion might be tested.

Schulze uses "dorsal" and "ventral" for the entire halves of the body respectively, the extreme surfaces are "dorsan" and "ventran," the direction toward them "dorsad" and "ventrad." The perlateral axis has "dextral" and "sinstral"

number of other terms synonymous with rostral and caudal, viz. atlantal and sacral, oral and aboral, proral and prymnal, actinal and abactinal were brought forward, even "Alpha ende" and "beta-ende" and the accompanying "alphal, alphan, alphad," "betal, betan, betad" were proposed for the two ends of the principal axis in bilateral animals.

halves, the ends are "dextran" and "sinistran,"[6] the direction toward them "dextrad" and "sinistrad."

The intersection of the axis is as before "centrum," the neighborhood "central," the direction "centrad." All the parts lying in the imaginary plane passing through the principal and ventro-dorsal axis are "median," the neighborhood is "medial," the more distant region on either side is "lateral." The direction toward the median plane is "mediad," direction toward the side is "laterad." Medial does not appear to be any improvement upon Barclay's term "mesial" or Wilder's modification "mesal" for the same plane. The latter in fact is preferable both on account of prior use and brevity. The extreme outer lateral parts or surfaces are "dextran" and "sinistran" like the ends of the axis, the direction toward these "dextrad and "sinistrad." Thus the two halves of the body are dextral and sinistral but the hands and feet are dextran and sinistran, the arms and legs extended dextrad and sinistrad of the dextran and sinistran surfaces of our bodies, and the right elbow is dextrad of the shoulder but mediad of the wrist.

This statement according to Wilder and Gage should be that "the right elbow is distad of the shoulder but proximad of the wrist, " mediad and mesal being restricted to the trunk or used only for the general statements with regard to the limbs. Usage derived from Barclay would apply proximal and distal wholly to the appendages, distal being toward the free end and proximal at or toward the attached end. Wilder and Gage use these terms in this restricted sense and Comstock gives them an identical meaning. Butschli in the discussion quoted above in note also maintained that these terms should be applied only to appendages and parts outside of the mass of the body. That Schulze had no such limitations in mind when framing his terms seems to be settled by his suggestion to use proximal as a synonym for central, and

---

[6] Wilder and Gage use the term "aspect" in the same sense as Schulze words ending in "an," or Barclay's ending in "en"; thus there is the cephalic aspect and ventral dorsal, lateral and sinistral aspects. The strongest objection to these terms is the fact that they are not mononymic, whereas Schulze's terms fulfil this requirement.

his application of distans to the peripheral parts and the similar use of terms ending other in " an. "

Comstock in his " Guide to Practical Work in Entomology"[7] says that dorsad, ventrad, cephlad, etc., indicate direction in parallel lines having infinite extension. " In other words these terms must be used in a way analogous to that in which we use right and left. " Lines which converge according to small explanatory wooden model kindly sent me by Prof. Wilder, are described by him as " caudo-laterad " when directed from the head end to the sides, cephalo-mesad when in the opposite direction, " dorso-latero-cephalad " when diverging from the caudal extremity toward the dorsum and side and so on.

The plane passing through the principal and perlateral axis is termed by Schulze the " frontal " plane (a poor word as acknowledged by Schulze). This divides the ventral from the dorsal regions, but Schulze seems to get into trouble here and omits the usual list of terms for neighborhood. These must be dorso-frontal and dorso-frontad, very awkward terms and about as inconvenient as ventro-frontal or ventro-frontad, but dorsan, dorsad, and ventran, ventrad for the outer parts, come into line again without difficulty. It would appear more natural to designate this as the perlateral or lateral plane or the tergo-frontal plane. This would enable one to designate the neighborhood on either sides as frontal and tergal and the directions toward the plane as frontad and tergad, any part in the plane itself would then be tergo-frontans or frontens, etc. Tergo-frontal would not interfere with the normal use of these terms on either side of it and be also in accord with dorsal, dorsad and ventral, ventrad, for the ventral and dorsal regions respectively, and would designate the duplex relation of this plane passing as it does between two distinct regions of the body.

The third plane passing through the dorso-ventral and perlateral axis, is the " transversal " dividing the rostral from the caudal regions of the body; the parts lying in this plane are " transversan " and the direction " transversad " ; rostral, ros-

---

[7] Ithaca, University Press, 1882, p. 9.

tran, rostrad, caudal, caudan and caudad also work well for the remoter parts. All planes lying parallel to any of these within the body are distinguished by the prefix "para."

Wilder and Gage have already recommended and now habitually use many of the terms also adopted by Schulze, but their system was tentative and did not aim at completeness. They, however, have used effectively "ental" and "ectal" terms not noticed by Schulze. Thus "the dura (mater)" is "ectad" of the brain but "entad" of the cranium. A part may be divided by cutting either ecto-entad or ento-ectad." There is also another application of words derived from ἐξτος and ἐντός which seems an obvious advantage. Ectal, ectans and ectad can be of great use if limited exclusively to parts that protrude from the surface of the body, like the appendages in Vertebrata, Crustacea, the spines of Echinoidea, the arms of Crinoidea, the tentacles of Actinoza and the like. Parts that stand out from the distan or terminan, rostran or caudan, dorsan or ventran surfaces of the body. If this were done the limbs would all be described as ectal of dextran and sinistran surfaces, the articulations of the body would be "ectad" or "entad" of those surfaces or their origin, if penetrating deeper might be designated by an appropriate term according to the topical terms already employed, central, proximal or distal. All the minor divisions of the ectal parts could then be referred to the surfaces of the body. Thus the bases of the spine in Echinus would be ectad of the body but proximad of its surface, while the termination would be distan with relation to the same surface, and it would have its own centrum and central region, principal axis, and so on.

In applying these words to a deeper seated part as to the radiating spines of Radiolarian or the threads of the stalk of a Hyalonema the use of "ental" to designate the part inside of the distan surface of the body would not entail confusion, since it would be used in direct connection with the description of the spine or threads. The stalk of Hyalonema in the most complicated example would be ental in origin, arising in the distal. It would be better to say the oral or actinal part of the central axis, pass through the centrum and

aboran regions and extend ectad, spreading out during its progress into a support suitable to anchor the body of the sponge in the mud below. The spines of Xiphacantha would be ento-ectal (extending from the centrum to the distans[7] surface and then ectad) having their origin in a central mass, possessing radiating spines on the distan surface and passing ectad of these to a variable distance.

Professor Gage objects to this in the following words "It seems to me the suggestions with reference to ectal, etc., are not happy. Proximal and distal seem to me to express nearness and remoteness of appendages to the part from which they arise. That may be reference to a limb or the trunk taken as the origin. For example, the arms and legs are appendages of the trunk, their distal ends being the hands and feet and the attached ends the proximal. So just as properly, in accordance with the established use of proximal and distal, the attached end of the hair is its proximal end while the free end is distal. This is true whether the hair is on the trunk or an appendage. I think the use originally made of ectal and ental by yourself (Wilder) the best one, the fundamental idea is in the compounds Ectoderm and Entoderm."

These criticisms coming from such a source and appealing to the derivation of the words are consistent with the Barclayan system and would be very convincing but for one thought that makes me hesitate to abandon this suggestion until I can learn more from experience. If the terms ectal and ental are to be applied to parts without reference to their origin, but simply because they are external and internal, it is obvious that they cannot be restricted any more than the words, outside and inside. If one is describing a spine or appendage of any sort the surface is ectal, the inner part ental, but if one is describing the body with reference to its appendages, the spines are ectal or they may have parts within the body and these are ental. The limbs of the Vertebrata and Crustacea may be considered either with reference to the surface of the body or to the skeleton, but the stalk of a hyalonema and the spine of Radiolarian may originate from the centrum itself.

---

[7] A better word here is peripheran.

THE SCOPE OF MODERN PHYSIOLOGY.[1]

BY FREDERIC S. LEE.

A review of the present aspect and tendency of a rapidly growing science in the light of its history may not be without profit. It may help to clearer vision and more exact orientation; and it may direct and stimulate investigators. These thoughts, together with the prevalence of an apparent misconception regarding the true aim and scope of Physiology, have led to the following paper.

To one who is acquainted with modern biology, it will seem unnecessary to repeat that physiology is the science of function or action; that it is to be contrasted with morphology, the science of form or structure; that these two form the grand divisions of the science of living things, or biology; that, just as there is an animal and a vegetable biology, so there is an animal physiology and a vegetable physiology; that, further, every species has its physiology; that every portion of living matter, be it organism, organ, tissue, cell, or simplest group of molecules deserving the name protoplasm, Weismann's biophor, has its physiology; that, for whatever functions or acts, there must be possible a science of function or action. All this seems self-evident and trite to the biologist. By the non-biologist its truth is being overlooked constantly. To him, forgetting that botany and zoology exist, the term physiology means merely *human* physiology, a most narrow significance and one that is productive of evil results. Undoubtedly the animal physiologists themselves have been responsible, unintentionally and unwittingly, for this common and radically false notion of the relatively narrow field of their science. In their zeal to penetrate the mysteries of that most wonderful and most interesting of all protoplasmic structures, the human body, and in their desire to perfect a strong foundation

---

[1] Read before the Section of Biology of the New York Academy of Sciences, November 20, 1893.

for the science and art of medicine, it was to be expected that their investigations should have an "anthropocentric" bias and that physiology and medicine should be born and grow old together. Let a union so intimate be once established, let centuries of tradition surround and strengthen it and the separation is not an easy process. With special reference to this question and at the risk of treading upon well-known historic ground, what has been in brief the history of animal physiology?

It is convenient to divide it with Preyer into five periods; the first four ending approximately with the dates 350 B. C., 160 A. D., 1628, and 1837 respectively, the fifth extending to the present time. The last four periods are characterized by one or more prominent investigators, the second by Aristotle, the third by Galen, the fourth by Harvey and Haller, the fifth by Johannes Müller.

The beginnings of animal physiology were contemporaneous with the speculations of the earliest natural philosophers and the labors of the earliest physicians. In Egypt, in China, in India, in Greece, the origins of the science are necessarily indefinite and, with the help of occasional fragments of historical fact, must be left to our imagination. The inclination toward self-study is an innate human characteristic and the more obvious facts of man's bodily functions could scarcely have failed of notice. Something was doubtless learned from the bodies of men killed or wounded in battle, and from the slaughter of animals for food. More precise observations were made upon sacrificial animals for purposes of divination. But facts thus obtained were necessarily isolated, and abundant speculation was the distinguishing characteristic of the whole period. From its shadowy beginnings down to the death of Hippocrates and Plato, the theories that were held regarding the origin and nature of life, unsupported, as they were, by observation and experiment, could not establish a science of vital action. Even Hippocrates himself, skillful as he was in the treatment of diseases, was no physiologist.

At the beginning of the second period was Aristotle, the first systematic observer of natural phenomena. His knowl-

edge of physiological fact was derived, as is well known, in greatest part from his own observations on man, the lower animals, and plants; and to a large extent it forms the basis of all subsequent development of the science. His pupil, Theophrastus, founded the science of vegetable physiology. Contemporaneous with Theophratus was the development of the great school of medicine at Alexandria, and here, under Herophilus and Erasistratus, animal physiology, along with anatomy and pathology, as a part of medicine undoubtedly made great progress. The extent of that progress can be inferred only imperfectly from later writers. The loss of the Alexandrian records is most lamentable. Aristotle had dissected animals; the Alexandrians dissected the human body and, more important for our science if true, it is possible that they performed experiments on animals. The facts made known by Aristotle were added to; physiological material accumulated. Thus, while the first period had been speculative, the second was descriptive. But not yet was there a *science* of function.

Then came Galen, the great physician, investigator, and writer, and it was he who organized the mass of knowledge that through the centuries had been growing. From Galen's time animal physiology has had a recognized position as a branch of natural science. A modern writer[2] says of him: "In the midst of contending factions he alone and for the first time shaped physiology into an independent science. He established physiology as the doctrine of the use of organs; he experimented upon animals * * *; and he suggested questions which he answered by the aid of such experiments. In opposition to all his predecessors and contemporaries, he maintained physiology to be the foundation of medicine. Further, he, first of all and so far as it was possible at his time, described and explained the functions methodically and completely. Upon the one side he sought to refer vital phenomena to natural causes, and upon the other he lauded their purposeful character, with expressions of admiration for the wisdom of the Creator, while their fitness aided him in explain-

---

[2] Preyer, *Allgemeine Physiologie.*

ing them. * * * The fact that the Galenic physiology, wherever it was known, prevailed for fifteen hundred years is due to its two-sided development. For physicians accepted it because of its materialism, and the clergy because of its teleology. Since Galen was an extraordinarily sagacious thinker, an uncommonly learned man, an industrious, systematic, truth-loving worker and skillful physician, never neglecting practice for research nor research for practice, of all the medical fraternity he seemed best fitted to lay the corner-stone of physiology as a science in itself. And it testifies to his genius that, in the whole thousand years following him, Galen's physiological system, constructed through his originality and the power of his logic, endured as law, seriously opposed by no one. The history of no science can show the like. Faith in the authority of Galen's name finds its equal only in the history of religions." It is to Galen's influence, doubtless, more than to that of any other, that the intimate union of physiology and medicine, continuing even to the present day, is due. And to him likewise we must ascribe the present prevailing idea, already spoken of, of the essentially human character of the science. Galen's physiology was in essence a human physiology; and the new science fully born became the handmaid of medicine. Galen's authority was supreme until the age of the Renaissance, and throughout the long mediaeval period animal physiology was at a standstill. Toward its close the Italian universities were established and men began to think for themselves, to read nature in addition to the books, and gradually to learn that nature and Galen did not always agree. The elaborate and ill-founded hypotheses of the spirits, the elements, the qualities, and the humours did not accord with the progressive, investigating spirit of the Renaissance and rebellion against the master gradually grew in strength. Paracelsus burned in public at Basel the works of Galen. More destructive than fire were the anatomical investigations of Vesalius and Fallopius. And in physiology Colombo and Caesalpinus prepared the way for the most important single discovery of the times. This event, which more than all else demonstrated the ineffectiveness of pure speculation and the

need of a rational method of observation and experiment, was none other than the discovery of the circulation of the blood.

With the announcement of this to the world in 1628, what we have called the fourth period of physiological history begins. Harvey's book, "*De Motu Cordis,*" is a model record of an ideal scientific investigation. The accumulation of an abundance of the essential facts, obtained by a most careful and systematic study of nature, the clear understanding of their logical positions and their mutual relations, and then, unhampered by scholastic systems and *a priori* considerations, but guided only by a regard for truth, the orderly arrangement of the accumulated material into the one possible rational system—such was Harvey's method. The result was incontrovertible. The full title of Harvey's work is "*Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus,*" but Harvey himself, being a physician, and his contemporaries and followers naturally enough considered more especially the human bearings of the established facts. For two hundred years after, discovery followed discovery, and the permanent foundations of the various subdivisions of physiology were laid—circulation, respiration, animal heat, the functions of the central nervous system and of the peripheral nerves, movement, animal electricity, reproduction, optics and acoustics. Haller's well-known contribution was that of the independent irritability of muscle. Of perhaps as much value were his complete knowledge of physiological literature and his activity in writing. In 1747 he published a text-book, the "*Primae Lineae Physiologiae,*" and in 1757 the large and complete "*Elementa Physiologiae Corporis Humani.*" These books were widely circulated and the entity of the science was forever established. The title of Haller's larger work, "Elements of the Physiology of the Human Body," indicates that its "anthropocentric" character was stamped firmly upon it. By its independent growth, its subordination to medicine was, however, already weakened.

To enumerate its advances during the past fifty-six years, the fifth period, would be a task of great proportions. The

man to whom it is customary to give the credit for having outlined the path that was to be followed during his lifetime and for the generation that has elapsed since his death, the teacher, either personally or by his writings, of the veterans, Ludwig, Du Bois Reymond, Brücke and Helmholtz, was Johannes Müller. Müller's name will at once suggest the one important principle that he formulated, that of specific nerve energies, but his writings and discoveries cover a wide field. His extraordinary knowledge, energy, enthusiasm and stimulating power were all-important during a period so rich with biological achievements. It is perhaps a fair question, whether Magendie, with his marvellous activity as an experimentalist, may not dispute with Müller the honor of having given to the physiology of the past fifty years its characteristic trend. Certain it is that he fathered the science in France (Claude Bernard was his pupil); that his writings were read much across the Rhine; and that the labors of the Germans have been, like his, the collecting of facts rather than the constructing of systems. Within this half-century the establishing of the two great doctrines of physics, the mechanical theory of heat and its greater corollary, the conservation of energy, were of indispensable aid to the development of physiology. The idea of vital force had taken on many forms and the controlling principle of life had played its part under many titles. But, when it was shown that in the inorganic world the various kinds of energy are mutually interchangeable, physiologists, long hampered by and impatient under the old ideas, eagerly siezed upon the new, in fact, aided not a little in their discovery, and proved that they applied to living things as well as to the not-living—and, with this, freedom from unscientific speculation was won; the animal is a machine in a sense more complete than the Cartesian one. On the purely physiological side of biology, this is undoubtedly the greatest achievement of the present century. Until the substance of the plant and the animal body could be regarded as subject to the same laws that controlled all other matter, much must have remained mysterious and inexplicable and physiology could not be reckoned as all in all a

natural science. Psychology has always been hampered by the speculations of the system-loving metaphysicians. More actual fact and less conjecture are essential to the scientific method; and the scientific method is the method of progress. Following this freedom from the doctrine of vital force, physiology has developed actively along two main lines, the chemical and the physical including the mechanical, and is now often defined as the chemistry and the physics of living matter. An astonishing number of discoveries have been made, and the outlines that were sketched by Galen and Harvey and Haller and Müller and Magendie have been filled in with remarkable rapidity and completeness.

Let us consider for a moment the prominent characteristics of the work of this period. In the first place, Vertebrates have received more attention and have been the subject of more systematic investigation than Invertebrates. And among the Vertebrates, with the exception of the indispensable frog, which, however, is rarely regarded as a finality in research, the Mammals, being nearest to man have been most studied. Second, the number of forms used is very small; it is probably safe to say that the genera employed in four-fifths of the researches could be counted easily upon the fingers of the two hands. Third, adult animals have been used almost exclusively. Fourth, the study of organs has prevailed, i. e., the investigator has endeavored to discover the chemical, physical and mechanical laws by which the heart, the lungs, the glands, the muscles and the brain perform their respective tasks. These characteristics are the natural outcome of the birth and growth of the science. They indicate that, although the results accomplished are widespread and of the greatest value, there are left almost untouched still wider fields. The achievement of so much, however, along the lines of the past is stimulating to the student of to-day, for it has made possible the more rapid development of the science in the new directions, in which it is now tending. To these we shall return shortly.

I think that the historian of the present period will not fail to be struck by the comparative paucity of hypothesis in

physiological research, especially when our science is contrasted with the other great division of biology. It is as if men had been nauseated by the vitalistic doctrines and other wild guesses of the past and had resolved hereafter to hold strictly to the Baconian method. At the risk of being misunderstood and criticised, I cannot help feeling that this is to be deplored. The method of all physical science is truly observation and experiment; facts must be discovered and grouped and the laws formulated therefrom. But, in the search after facts, the inestimable value of hypothesis—of speculation, if you will—cannot be denied. It directs the searcher along a definite path and gives for the time being an encouraging and stimulating coherence to his results. If later his speculation becomes verified, well; if it proves false, its use is not to be deprecated, for it has served its purpose as an aid to discovery: The facts still remain, science is by so much the gainer, and with a new interpretation and a new hypothesis nearer the truth further advance will be made. The trouble is to keep the speculation within rational bounds and to know when to give it up. To employ it too sparingly is to retard scientific progress, and it seems to me that just here the animal physiologists of the present period are open to criticism.

Further, it is to be noted that until far into this period throughout the Continental, the English, and most of the American universities physiology and anatomy have together formed one department. At Bonn from 1826 to 1833, and at Berlin from 1833 until his death in 1858, Müller occupied such a common chair. Helmholtz held a similar position in Bonn from 1855 until 1858. Now, everywhere, animal physiology presupposes anatomy, and each science has its own field and its own methods. Further still, physiology usually occupies a place in the Medical faculty. This also is the result of its historical development. As I have shown, it is to the medical fraternity, more than to any other one class, that it owes its great progress in the past. But a glance at the literature of the present period will show that, largely through the efforts of its medical promoters, it has widely overstepped its early

medical boundaries. It has long since ceased to be a purely medical and anthropological science; it has become a biological science. Human physiology, like human anatomy, will necessarily always form one of the foundation stones of a medical training, and perhaps the most important one. But human physiology is but one branch of a science as broad as are the domains of protoplasm. Man's body is a machine, but it is a machine that has had a history. It is an achievement to learn to know the mechanical, chemical, and physical laws of this most complex of vital mechanisms. But the task of the physiologist does not end here—I should say it does not begin here. To know the action of the mechanism without its history is not only short-sighted, it is impossible. This is being recognized and a school of general and comparative physiologists is arising. During the present period, then, beside its great advance along the older lines, our science has begun a development along broader biological paths. It has won a place as an independent, pure natural science. More and more are its claims to admission to Pure Science and Philosophical faculties being recognized. It should be placed and will be placed by the side of chemistry, physics, and the morphological division of biology. I do not think it an exaggerated statement, that the tendency of biological thought at present is toward extraordinary activity along physiological lines.

(*To be continued.*)

THE ORNITHOLOGY OF NEW GUINEA.

By George S. Mead.

(*Mainly from the French of Meyners d'Estrey.*)

The Fauna of New Guinea shines almost exclusively in the variety and beauty of the birds, that are dispersed more or less over the islands surrounding the Papuan continent. Among these islands should be cited those more removed, such as Arrou, Adi and Sabouda, Misole, Salawatti, Batanta, Gagi, the isles of Gebe, King William and Waigeou as well as the principal islands of the great Bay of Geelvink.

It is calculated to-day that more than 400 species of birds belong to this region and it is probable that this number is very far below the correct estimate. The interior of the continent is certainly reserved for great surprises especially when we have become acquainted with the high plateaus of the country.

Of these 400 species, most numerous are those belonging to the families of parroquetts, kingfishers, flycatchers, honey-birds, crows, pigeons and herons. Others more rare, are representatives of the owls, sparrows, hornbills, bee-eaters, woodcocks and ducks.

Among the birds of prey, should be mentioned for its size—*Haliaëtus leucogaster*, which is found all through the Papuan Archipelago, especially the islands of Arrou; but it seems that it does not come to the Bay of Geelvink. The same is true of *Haliaëtus indicus*, while *Pandion haliaëtus* is met with everywhere. *Spizaëtus gurneyi* is the least common of all the birds of prey in the Indies and one does not meet it as a rule at Gilolo and the islands adjacent. Rosenberg obtained a specimen at Salawatti but did not see others.

Astur novæ hollandiæ is equally rare; Rosenberg killed one of these beautiful birds during his sojourn in Mefore. It strays as far as Java where occasionally it nests, and where the natives know it under the name of Tere.

Baza reinwardtii is seen everywhere, especially in gardens in the neighborhood of the huts.

The impenetrable forests under which the country is in some degree buried, serves as a refuge for certain kinds of owls, where it is difficult to take them on account of their solitary habits. Yet they are widely dispersed, and their peculiar cry is frequently heard in the silence of the night even near dwellings and in the center of villages.

New Guinea is par-excellence in Oceania the land of parroquetts. There are known to-day more than thirty species. Many occupy a wide extent of territory; for instance—*Cacatua triton*, *Microglossus aterrimus*, *Eclectus polychlorus*, *Trichoglossus hæmatotus*, *Lorius scintillatus*, *Nanodes placens* and *Nasiterna pygmæa*.

Others are confined to narrow limits: for example—*Lorius cyanauchen fuscatus*, *Nanodes musschenbrœkii*, *Psittacus brehmii et modestus*, *Psittacula melanogenia* and *Dasyptilus pecquetii*. The vertical dispersion of these species is very limited.

Microglossus alceto, *Eclectus westermanii* et *corneliæ*, as also *Lorius semilarvatus*, whose habitat it was supposed was in New Guinea, have never been seen there. It is surprising to find in the little island of Goram, near Ceram, *Cacatua triton*, whereas one might rather expect to see there *Cacatua moluccensis*; it is likely, however, that the former as well as the baboon *Cynocephalus niger* of Batjan, was brought originally to Goram and became wild again there.

Representatives of very many species of cuckoos are here met with; among them *Centropus menebeckii* and *sonneratii* are very common. *Cuculus leucolophus* and *striatus* on the other hand are quite rare.

Among the swifts that are found everywhere, two species especially should be mentioned, viz., *Cypselus mystaceus* and a Collocalia. We may name here also a large species of goatsuckers—*Podargus papuensis*, which inhabits chiefly the islands of Arrou, Waigou and Mefore.

New Guinea is extremely rich in sun-birds, as for example—the *Nectarinia*, *Ptilotis*, *Glyciphila* and *Melliphaga*. The large number of birds of this family as well as of the *Malurus* comes

from the blending of the fauna of the Moluccas with that of Australia which are united at it were in New Guinea.

Of the family of thrushes one meets here only three species of which *Pitta novæguineæ* is the most widely extended. The specimens which Rosenberg obtained from the isle of Sowek are different from the others in his account and have been described by Schlegel under the name of *Pitta rosenbergii.*

Flycatchers and analogous species abound in New Guinea and the adjacent islands. They are found without exception on the warm leeward coast.

One finds also frequently in these same islands many species of *Edolius* and *Graucalus* as well as *Eurystomus gularis,* which inhabits the entire Archipelago.

Artamus was not seen by Rosenberg either on the islands of Arrou or Misole, whereas *Cracticus cassicus, Tropidorhynchus novæguineæ* and *Lamprotornis* showed themselves everywhere in great numbers.

Of sixteen species of Kingfishers, *Dacelo gaudichaudii* is the most abundant; *Tanisyptera carolinæ* and *riedelii* are scarce. *Alcedo pusilla* and *solitaria* are quite rare, as well as *Dacelo torotoro.* All these birds frequent the leeward coast to the foot of the mountains.

One species only of hornbill is known in New Guinea—*Bucerus ruficollis.*

The family of Crows is well represented. Among them may be specially noticed *Corvusorru* with its bright-blue eye, and *Chalibaeus ater* of the color of steel.

The Birds of Paradise of which several species are known, are all from New Guinea, and the islands adjacent.

The distribution of some of these species presents some singular facts. One finds amongst others *Paradisea rubra* in Waigeou and Batanta, while at the same time it is not to be found at Salawatti, separated from Batanta only by the strait of Sagevien, which is is not very wide and which these birds could easily cross on the wing.

Paradisea papuana is not met in Salawatti, although this island is nearer the mainland (New Guinea) than Misole where it is said the bird is not lacking.

Paradisea regia is more widely dispersed, and *Paradisea apoda* much less so, for it is confined exclusively to the islands of Arrou. The former is found not only here, but in Misole, Salawatti, Jobi and the mainland.

Paradisea rubra haunts the islands of Waigeou, Gemien and Batanta.

Paradisea magnifica or *speciosa* makes its home in Misole, Salawatti and Jobi.

Paradisea wilsonii is found only in Waigeou and Batanta.

All the above mentioned seek the hot coast lands on the leeward side, while the two following keep at least 2000 feet above sea-level, viz.: *Paradisea sexpennis* and *Paradisea superba;* the latter is confined to the mountains of New Guinea solely.

Paradisea wallacei is found only in Halmahera and Batjan.

In the countries where the Birds of Paradise live, they constitute the bulk of the birds. The work of Wallace gives curious information concerning their habits and mode of life. Rosenberg also writes at length about them in his Notes of a voyage to the islands southeast of the Indian Archipelago. According to his statement the males and females of *Paradisea superba* were the first *undamaged* specimens of this rare species ever seen in Europe.

Epimachi (Plume-birds), species that vie in its plumage with the Birds of Paradise, are found only in New Guinea and Salawatti. Neither Wallace nor Bernstein was able to procure the *Epimachus speciosus* and *gularis* although the latter offered a reward of 80 francs for fine specimens.[1]

Epimachus magnificus and *resplendens* inhabit the mainland. The last is also encountered in Salawatti, in some places even in great numbers.

In Ternate Rosenberg met a traveller, who had brought a small collection of objects of natural history from the North coast of New Guinea, among them one bird in particular that attracted his attention. It was a new species unknown to science, the shape and tints of which resembled those of the female *Epimachus*. An offer was made by Rosenberg for the bird in order that he might secure it for the museum of Leyden,

---

[1] Confined exclusively to the Mountains of New Guinea.

but was refused. The specimen had been somewhat badly prepared and was not perfect. In compliment to Professor Veth, the savant who did so much to extend our knowledge of ethnology and geography of the Netherland East Indies, Rosenberg named the bird *Epimachus vethii.* Excepting the head, throat and neck the bird was of a brown color (*fuscus*); the upper part of the head was very dark; the back and upper side of the tail were ferruginous, the latter brown in the center. The breast was of a brownish-white, darker below and transversed by arched lines; the beak was curved and black. The length of the bird was about 35 centimetres, of which the tail made 14, the beak 7. The fourth plume was very long. D'Albertis and Meyer when later they visited the district of Arfak and other regions near the Bay of Geelvink, saw this bird which Sclater has named *Drepanornis albertisii.*

We find in Papua only four species of *Paradisiers Loriots,* viz. *Oriolus aureus* and *xanthogaster* that are confined strictly to the continent, *Oriolus flavicinctus* in New Guinea and the islands of Arrou, and *Oriolus striatus* in New Guinea, Waigeou and Salawatti. In museums there are scarcely any perfect specimens of these beautiful birds.

The *Gallinæ* are represented by only four families which, with the exception of the *Otidiphaps,* are found everywhere.

There are great numbers of Pigeons, forty species at least of which are known at present. Some of these are widely dispersed, others are confined to narrow limits.

Three species of Cassowaries live in these parts:—*Casuarius bicarunculatus* which is seen in the islands of Arrou; *Casuarius uniappendiculatus* found in Salawatti and on the northwest coast of New Guinea; and *Casuarius papuanus* inhabiting Arfak and the island of Jobi. These birds seek the flat hot lands but not the marshes.

Rosenberg describes a beautiful live specimen of *Casuarius uniappendiculatus* at Ternate, which was offered to him by the Rajah of Salawatti. This bird was about two years old and had nearly attained full growth although it still wore the brown plumage of its youth. The lovely golden shade of the neck which appears soon after birth, shone in full splendor but

the azure of the head was not so vivid. The bird was very tame, liking men but hating dogs and cats.

The Dromalectores, *Tallegallus* and *Megapodius*, are found everywhere excepting in the mountains.

The Waders frequent the coasts generally, particularly *Tringa* and *Totanus*. There are also many herons, especially in the Archipelago of Arrou, at the straits of Gallewo and in the island of Waigeou.

Aquatic birds are rare, excepting perhaps in Arrou; some species are *Sterna pelecanoides*, *torresi* and *dougalii*, *Podiceps gularis*; lastly the ducks, *Anas arcuata* and *radja*.

NOTES ON A SPECIES OF SIMOCEPHALUS.

F. L. HARVEY, ORONO, ME.

In a gathering from a spring swamp near Orono, Me., brought into the laboratory by Mr. O. W. Knight, one of my pupils, was found a fresh water crustacean in great abundance. The species is near *S. vetulus* Mueller, but as it differs in several points from the descriptions and figures of that species given by Herrick in his Minnesota Reports, the following observations, accompanied by drawings, are made regarding it.

The striæ in our specimens arise on the ventral margin from *triangular* or *quadrangular* spaces instead of *hexagonal* as stated by Herrick. See Fig. 4. These striæ are often anastomosing and lost in the dorsal region in fine reticulations. The prominence on the posterior part of the shell is variable; obtuse, or obtuse-angled and occasionally obsolete, and also variable in position. It is usually near the dorsal region but in one specimen it is located in the middle. It is always armed with blunt teeth, which extend above and below along the posterior margin of the shell. See Fig. 1. Head often concave in front, though in some specimens rounded as shown in Herrick's figures. Eyes placed near the end of the beak, round, bordered with circular clear cells and bearing on the front, six or seven circular facets darker than the general ground color. What is called the eye seems to be an eye spot bearing dark colored *ocelli*, reminding one of the eye spot of a *Thysanuran*. See Fig. 5.

Inferior antennæ fusiform, bearing in front a prominence armed with a stout spine, which is bulbous at the base and 90μ. long. The body of the antennæ encircled by about six rows of minute blunt teeth, one row of which adorns the distal margin. From the end arise two series of four slender setæ, bearing small bublets at the end. See Fig. 6.

Superior antennæ large. There are three short joints at the base which give great freedom of motion between the

long antennal joint and the body. The antennæ seem to us to be four-jointed below the rami, and this view is strengthened by the fact that in the young the three short basal joints are plainly marked. See Fig. 2. The third basal joint bears on the posterior a prominence armed with two slender spines. These spines show also in the young. See Fig. 2. The fourth, a long stout joint of the antenna, bears on the anterior distal end, a short spine 45μ. long. All the joints of the antennæ are ornamented with encircling rows of minute blunt spines, one row of which is located on the distal end. Rami of the antennæ *three.* The *outer* four-jointed, the basal joint short and unarmed, the second armed with a *short spine* and *not* bearing a *long two-jointed one as shown in Herrick's figures.* The two-jointed setæ arming the other joints of the outer and inner rami are *plumose* the *whole length* and *not naked below as shown by Herrick.*

Third ramus short, located at the base and between the others. Composed of *three* joints, *not two as stated by Herrick.* See Fig. 7.

The basal joint short and broad, the second joint fusiform, the terminal slender and hyaline. See Fig. 7.

The prominence in front of the anus armed with eleven spines, the anterior longest, all curving backward. Body back from the anus abruptly angled and *not gradually sloping* as shown in Herrick's figure. See Fig. 3. There are two long caudal spines at the posterior part of the body not shown by Herrick. See Fig. 3. At the posterior ventral angle of the shell are *four, not three, short stiff* setæ, differing from the slender plumose setæ forward. The setæ arise not from the *margin,* but a considerable distance above the edge of the shell and extend below it. The body of our form is much broader and deeper in relation to the length than shown in Herrick's figures.

In the body above the abdomen in most females were five oblong bodies. While examining one specimen, these bodies began to show motion, and soon were expelled as living young. One of these young is shown in Fig. 2. The eye was two-lobed and the body filled with spherules of a greenish brown color.

In all characters not mentioned, this form agrees with *S. vetulus*, Mueller. Whether the above differences can be explained by omissions and oversights by observers is not known. The sharp angle of the posterior part of the body, the caudal setæ, the reticulations of the shell, the plumose basal joint of the antennæ and the *three joints* of the third ramus of the superior antennæ are enough to characterize a new species near *S. vetulus* Mueller. I have a supply of alcohol and glycerine specimens, or can get living specimens another season, and will be pleased to send them to any one who has authentic specimens of *Simocephalus vetulus*, Mueller, for comparison, as I reluctantly make a new species of this form, never having seen *S. vetulus*, Mueller. We will be pleased to receive specimens of *S. vetulus*, Mueller from any one who has them.

Specimens varied in size from 1.5 mm. to nearly 3mm. Below is given measurements of a good sized specimen.

Measurements. Total length 2.67 mm. Total breadth 1.47 mm. Head from end of beak to where it joins the shell above, .785 mm. Sup. ant. .667 mm.—ratio of joints 10–1–4–3½–3½. Inf. ant. 140μ, including spines at the end—long spine in front 90μ.—terminal setæ 33μ. Eyes 107μ. d. Claws at post. end of body .3 mm.

Two setæ at post. part of body .38 mm.

Terminal setæ of ant. .59 mm. Reticulations on side of shell 35μ apart. Plumed setæ on interventral margin 115μ. Third ramus of sup. ant. 115μ, ratio of joints 2 : 5 : 7. Longest spine in front of anus 80μ.

EXPLANATION OF PLATE.

Fig. 1.—*Simocephalus* species showing the general outlines of the female. (Original.)

Fig. 2.—The young immediately after birth, showing the two-lobed eye and the basal joints of the antennæ. (Original.)

Fig. 3.—The posterior part of the abdomen showing the angle back of the anus and the posterior setæ. (Original.)

Fig. 4.—The triangular reticulations on the the ventral posterior margin of the shell. The petagonal and quadrangular cells, that sometimes occur above the marginal triangular cells are shown. (Original.)

Fig. 5.—The circular eye spot with marginal clear cells and the dark colored ocelli upon the face. (Original.)

Fig. 6.—The inferior antenna showing the spine in front, the two series of bulbous setæ at the end and the encircling rows of teeth. (Original.)

Fig. 7.—Short three-jointed ramus at the base and between the two large rami of the superior antenna, (Original.)

EDITORIALS.

—THOSE who hold place in our municipal government are necessarily "men of affairs," and are very rarely possessed of the love of nature. Their idea of a tree is primarily based on its market value, but if it be necessarily ornamental by reason of its position, their idea of beauty consists in truncated branches with a coronæ of sprouts surrounding their extremities. Forest is in their view only attractive when it is cleared of smaller growth, and grass sown in its stead; and thickets of shrubs and vines are necessarily to be burned. Hills must be leveled, ravines must be filled up, and nature's slopes must be replaced by dressed stone walls. At all this the lover of nature rebels for various reasons. Such interference with natural processes produces utter poverty, and wood and field are robbed of one of their charms, variety. In a park which receives such treatment, where ten species of trees grew, but one remains. From the hillsides the native shrubs have disappeared, and on the open, which was once a bed of flowers, there remains but the monotonous grass, reduced if possible to a single species. Such treatment destroys the haunts of bird and insect, and lays open the few venturesome wild things that remain, to the persecutions of the rabble, who would never otherwise know of their presence. It is important that this official vandalism should never enter our public parks, or that it should be speedily suppressed whenever it shows itself. Our parks are for the instruction of the public as well as for their relaxation. Stone walls and graded paths abound in the city, and mutilated trees line the streets. Let the parks be pictures of the great nature with its energies untrammeled and its processes in view of every citizen who wanders in their shades or repose on their banks. Let its forest teach the lesson of decay as well as of birth and life, and *abeste profanes*, hands off, of wonders that man cannot imitate or improve upon.

—VOGUE is a form of automatism, and it is natural to man, since it is always easier to imitate than to create. There are vogues in naming, vogues in studying, and some other kinds of vogues to which naturalists are liable, as vogues affect other men of other professions. We are moved to these reflections by the observation of the vogue which has been enjoyed for three quarters of a century by the alleged adjective *madagascariensis*. From *Daubentonia madagascariensis* to *Megaladapis madagascariensis*, a long processon of *madagascarienses*

has filed into place in our nomenclature, there to remain until time and language shall be no longer. To account for this phenomenon we we cannot point viridically to the euphony of the word, nor to the great economy of time and space which we secure by adopting it. That suggestion and automatism have much to do with this custom there can be no doubt, but we venture a hypothesis which may relieve us of the painful suspicion that this ready yielding to ones subliminal self may be due to poverty of classical knowledge or inventive capacity, or both. The originator of the term foresaw the possibilities of the Malagassy language for cacaphony, so to avoid such terms as antananarivoënsis, and amboulisatrensis, he set the fashion at madagascariensis, and so it has remained. It is true that there are a few species of animals inhabiting the great island which are not named madagascariensis, but they must always remain in comparitive obscurity. But it might be well to place the name on the retired list in view of its eminent services in the past, especially as there some new aspirants to public favor which will give it a competition too serious for its years. The cacophony mill which produces Propalæhoplophorus and Brachydiastematotherium is still in motion, and we look for new revelations which will utterly destroy the usefulness of madagascariensis by placing it among the words of one syllable in the nomenclatorial primer.

—There is at present no law for the punishment of poachers in our National Parks. As a consequence the officers in charge can only escort men who are detected in this invasion of the rights of the public to the boundary, and there discharge them. As a consequence poaching has become rather a pleasant pasttime than otherwise. The recent detection of some men who have for several years been killing bison in the Yellowstone National Park, will perhaps stimulate Congress to remedy the evil. A bill is at present in the hands of the Committee on Territories of the House of Representatives which will if passed furnish the necessary legislation. We hope that nothing will prevent its early passage by both houses.

—We learn that the Sundry Civil Bill as sent to the House by the Committee on appropriations has not reduced the appropriations for the scientific work of Government bureaus below the amounts paid last year. We should be thankful for this in view of the extremely economic tendencies of the present congress.

—The legislature of Missouri is hesitating to make an appropriation for the continuance of the zoological survey. It will make a serious economic mistake if it fails to grant the usual sum.

PLATE IX.

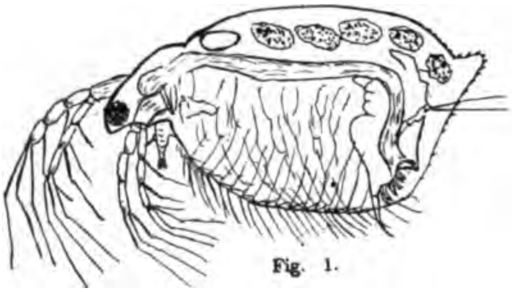


Fig. 1.

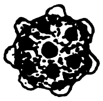


Fig. 5.

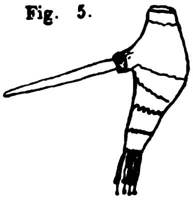


Fig. 6.

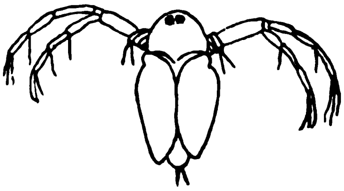


Fig. 2.


Fig. 7

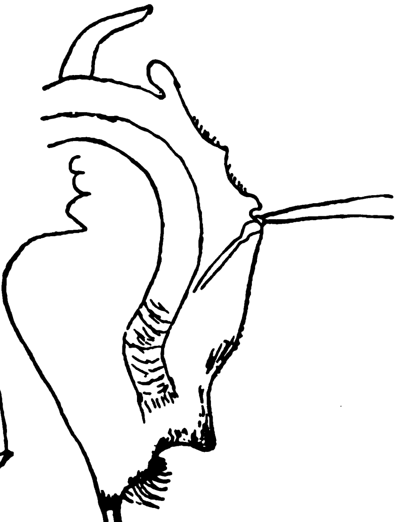


Fig. 3.

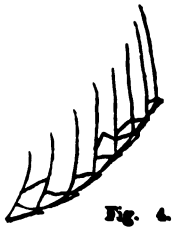


Fig. 4.

F. L. Harvey, Del.

Simocephalus vetulus, **Müller.**

RECENT BOOKS AND PAMPHLETS.

Annual Report of the Bureau of Ethnology for 1886—87. Washington, 1891. From the Smithsonian Institution.

Annual Report Geological Survey of Canada, 1890–91. Vol. V. Parts I and II. From the Survey.

BOLLMAN, C. H.—The Myriapoda of North America. Bull. No. 46, U. S. Natl. Mus. Washington, 1893. From the Smithsonian Institution.

Bulletin No. 21, 1893, Iowa Agri. Exper. Station.

Bulletin No. 92, North Carolina Agricultural Experiment Station, August, 1893.

CHAPMAN, F. M.—Description of Two New Races of Mammals from Florida, with Remarks on *Sitomys niveiventris* Chapman. Extr. Bull. Am. Mus. Nat. Hist., Vol. V, 1893. From the author.

CUMMINS, W. F.—Notes on the Geology of Northwest Texas. Extr. Fourth Ann. Rept., 1892. From the author.

DALL, W. H.—Land Shells of the genus Bulimulus in Lower California, with descriptions of several new species. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

DAWSON, SIR J. WM.—The Canadian Ice Age. Montreal, 1893. From the author.

DAWSON, G. M.—Geological Notes on some of the Coasts and Islands of Behring Sea and Vicinity. Extr. Bull. Geol. Soc. Am., Vol. V, 1894. From the Society.

DAY, D. T.—Mineral Resources of the United States for 1892. Washington, 1893. From the Smithsonian Institution.

DEPERET, M.—Sur l'age absolu des faunes des Mammiféres pliocénes du Plateau central et des éruptions volcaniques contemporaines. Extr. du Compte-rendu des séances de la Soc. Geol. de France, Sept. 16, 1893. From the author.

DUMERIL, A. ET BOCOURT.—Études sur les Reptiles et les Batraciens; Troisième Partie d. Recherches Zoologiques; Mission Scientifiques au Mexique et dans l'Amerique centrale. Paris, 1893. From the authors.

Eleventh Report of the California State Mineralogist (First Biennial). Two years ending September 15, 1892.

Fifth Annual Report of the Board of Managers of the Rhode Island College of Agri. and Mechan. Arts. Part II, 1893.

GOEBEL, K.—Gedächtnissrede auf Karl von Nägeli gehalten in der öffenlichen Sitzung der k. b. Akademie der Wissenschaften zu München am 21 März, 1893. München 1893. Im Verlag der k. b. Akademie. From the author.

HARLAN, MR. JUSTICE.—Opinions at the Conference in Paris of the Behring Sea Tribunal of Arbitration, constituted by the Treaty of Feb. 29, 1892, between Her Britannic Majesty and the United States of America. Washington, 1893.

HOBBS, WM. H.—On the Geological Structure of the Mt. Washington Mass of the Taconic Range. (Extr. Journ. Geol., Vol. I, 1893). From the author.

HOLLICK, A.—Observations on the Geology of Martha's Vineyard. Extr. Trans. N. Y. Acad. Sci., XIII, 1894. From the author.

Ihering, H. von.—Os Mammiferos do Rio Grande do Sul. 1893. From the author.

Johnson's Universal Cyclopædia, Vol. II. New York, 1893. From the Publishers.

Jordan, D. S. and Fesler, Bert.—A review of the Sparoid Fishes of North America and Europe. Extr. Report U. S. Fish Commissioner of Fish and Fisheries 1889–91. From the authors.

Lawson, A. C. and Posada, Juan de la C.—The Geology of Carmela Bay. Extr. Bull. Univ. of California, Vol. I, 1893. From the author.

Lebouaq, H.—Anatomie des formes extérieures du talon. Extr. Ann. Soc. Méd. de Gaud, 1893. From the author.

Leche, W.—Studien über Entwicklung des Zahnsystems bei den Saugethieren. Separat-Abdruck aus Morpholog. Jahrb. XIX, Leipzig, 1892. From the author.

Lydekker, R.—On two Dinosaurian Teeth from Aylesbury. Extr. Quart. Journ Geol. Soc., Nov., 1893. From the author.

Memoirs of the National Academy of Sciences, Vol. VI. Washington, 1893.

Miller, G. S.—Description of a New Mouse from Southern New Mexico and Arizona. Extr. Bull. Am. Mus. Nat. Hist., Vol. V, 1893. From the author.

Mitchell, C. P.—The enlargement of the Sphere of Women. London, 1892. From the author.

Osborn, H. F.—The History and Homologies of the Molar Cusps. Extr. Anat. Anz., 1892. From the author.

Palache, C.—The Soda-Rhyolite North of Berkeley. Extr. Bull. Univ. of California, Vol. I, 1893. From the author.

Piersol, G. A.—Normal Histology, including an account of the development of the Tissues and of the Organs. Philadelphia, Pa., 1893. From the author.

Pilling, J. C.—Bibliography of the Salishan Languages. Issued by the Bureau of Ethnology. Washington, 1893. From the Smithsonian Institution.

Prestwich, J.—On the Evidences of a Submergence of western Europe and the Mediterranean Coasts, at the close of the Glacial or so-called Post-glacial period, and immediately preceding the Neolithic or Recent Period. Extr. Phil. Trans. Roy. Soc. London, Vol. 184, 1893. From the author.

Rathbun, M. J.—Descriptions of new species of American Fresh Water Crabs. Extr. Proceeds. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

Report of the Commissioner of Education for 1889-90, Vol. 2. Washington, 1893· From the Smithsonian Institution.

Report of the United States Commission of Fish and Fisheries for 1889–91. Washington, 1893. From the Smithsonian Institution.

Report for the year 1892–93, presented by the Board of Managers of the Observatory of Yale University to the President and Fellows.

Ridgway, R.—Description of a new Storm Petrel from the coast of western Mexico.

——A Revision of the genus Formicarius Boddaert. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

Ritter, W. E.—Tunicata of the Pacific Coast of North America. I *Perophora annectens* n. sp. Extr. Proceeds. Cal. Acad. Sci., Vol. IV, Ser. 2, 1893. From the author.

STERKI, DR. V.—Observations on Vallonia. Extr. Proceeds. Phila. Acad., 1893. From the author.

STEVENSON, J. J.—On the Origin of the Pennsylvania Anthracite. (Extr. Journ. Geol., Vol. I, 1893.)——On the Use of the Name "Catskill." (Extr. Am. Journ. Sci., Vol. XLVI, 1893.) From the author.

TARR, R. S.—Glacial Erosion. Extr. Am. Geol., Vol. XII, 1893. From the author.

TULLBERG, T.—Ueber einige Muriden aus Kamerun. Mitgetheilt der Königl. Gesellschaft der Wissensshaften zu Upsala, 27 Juni, 1893. From the author.

WEED, C. M.—A descriptive catalogue of the Harvest Spiders of Ohio. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

WHIPPLE, L. E.—The Philosophy of Mental Healing. New York, 1893. From the Metaphys. Pub. Co.

WHITEAVES, J. F.—Presidential Address.——The Cretaceous System of Canada. Extr. Trans. Roy. Soc., Canada, 1893. From the author.

Wilder Quarter-Century Book. A collection of original papers dedicated to Professor Burt Green Wilder at the close of his twenty-fifth year of service in Cornell University (1868–1893). By some of his former students. Ithaca, N. Y., 1893. From Mr. Burt Wilder.

RECENT LITERATURE.

On the Classification of the Myxosporidia, a group of protozoan parasites infesting fishes. (Art. 10, Bull. U. S. Fish Commission for 1891, pp. 407–420. Washington, D. C., 1893). By R. R. Gurley.

This paper is a communication preliminary to a more extensive report at present in manuscript. Several new terms are introduced, a new classification is proposed, three new species described and twenty species mentioned by other authors, but not named, are given binomial names. All of these species will be figured in the final report.

The new terms are as follows: *pansporoblast*, the plasma-sphere from which the sporoblasts arise; *sporoplasm*, the protoplasm of the spore; *capsular index*, the ratio of the length of the capsule to the antero-posterior diameter of the shell-cavity; *pericornual nuclei*, the two nuclei (" granules," " globules ") at the antero-lateral angles of the sporoplasm or on the posterior extremities of the capsule.

Gurley's classification is based upon the symmetry of the spores as the most important taxonomic criterion and differs from Thélohan's classification in several particulars. Two orders with five families are recognized. One new genus (*Pleistophora*) is proposed; *Sphærospora* Th. and *Myxosoma* Th. are fused into a subgenus *Sphærospora* of the genus *Chloromyxum* Ming. The following key, based upon Gurley's tables and descriptions will show the plan of his classification.

Subclass *Myxosporidia*; pansporoblast produces—

I. Many (at least 8) minute spores, lacking distinct symmetry and possessing but one capsule Ord. *Cryptocystes.*
  A. Spores numerous, inconstant; pansporoblast membrane $\frac{1}{m}$
    a. Not subpersistent; myxosporidium present Gen. *Glugea Th.*
    b. Subpersistent; myxosporidium absent Gen. nov. *Pleistophora.*
  B. Spores constant (8); pansporoblast membrane subpersistent; myxsoporidium absent Gen. *Thelohania* Hen.

II. Few (2 at most) rather large spores with distinct symmetry and two or more capsules Ord. *Phænocystes.*
Spores symmetrical bilaterally; antero-posterior symmetry $\frac{1}{m}$
  A. Present Gen. *Cystodiscus* Lutz.

B. Absent; capsules in—
  a. Two groups, right and left wings; not bivalve — Gen. *Myxidium* Büt.
  b. One group, at anterior end; bivalve; capsules—
    α. Four — Gen. *Chloromyxum* Min.
    β. Two; inclination of plane of junction of valves to longitudinal plane
      *0°; vacuole present — Gen. *Myxobolus* Büt
      **90°; vacuole absent; sporoplasm unilateral — Gen. *Ceratomyxa* Th.

The family *Glugeidæ* includes the genera *Glugea*, *Pleistophora* and *Thelohania; Chloromyxidæ* includes *Chloromyxum* and *Ceratomyxum*, while the families *Myxidiidæ*, *Myxobolidæ* and *Cystodiscidæ*, each include but one genus.

As new species are described:—

1. *Myxobolus globosus* from branchial lamellæ of *Erimyzon sucetta;* globose, 7–8μ long by 6μ broad by 5μ thick; capsular index somewhat more than 0.50.

2. *M. transovalis* under scales of *Phoxinus funduloides;* 6–7μ long by 8μ broad; cap. ind. 0.50.

3. *M. macrurus* subcutaneous tissue of *Hybognathus nuchalis*; 10–11μ by 6–8μ by 4μ; tail 30–40μ; for further description see original.

The following species have been given binomial names:—

1. *Cystodiscus ? diploxys* from *Tortrix viridana*, vid. Balbiani, 1867.
2. *Myxobolus unicapsulatus* from *Labeo niloticus*, vid. Müller, 1841.
3. *M. inequalis* from *Pimelodus clarias*, vid. Müller, 1841.
4. *M. oblongus* from *Erimyzon sucetta*, vid. Müller, 1841.
5. *M. bicostatus* from branchiæ of *Tinca tinca*, vid. Bütschli, 1882.
6. *M. lintonii* from *Cyprinodon variegatus*, vid. Linton, 1891.
7. *M. obesus* from *Alburnus alburnus*, vid. Balbiani, 1883.
8. *M. cycloides* from *Leuciscus rutilus*, vid. Müller, 1841.
9. *M. spheralis* from *Coregonus fera*, vid. Claparède, 1874.
10. *M. perlatus* from *Gymnocephalus cernua*, vid. Balbiani, 1883.
11. *M. ? zschokkei* from *Coregonus fera*, vid. Zschokke, 1884.
12. *M. monurus* from *Aphododerus sayanus*, vid. Ryder, 1880.
13. *M. strongylurus* from *Synodontis schal*, vid. Müller, 1841.

14. *M. kolesnikovi* from *Coregonus fera*, vid. Kolesnikoff, 1866.
15. *M. linearis* from *Pseudoplatystoma fasciatum*, vid. Müller, 1841.
16. *M. schizurus* from *Esox lucius*, vid. Müller, 1841.
17. *M. creplinii* from *Gymnocephalus cernua*, vid. Creplin, 1842.
18. *M. diplurus* from *Lota lota*, vid. Bütschli, 1882.
19. *Chloromyxum mucronatum* from *Lota lota*, vid. Müller, 1854.
20. *C. incisum* from *Raja batis*, vid. Müller, 1851.

C. W. Stiles.

Stiles' and Hassall's Cestodes.—The publication by Dr. Stiles of several preliminaries, notably one in the *Centralblatt für Bacteriologie und Parasitenkunde*, 1893, No. 14–15, has led helminthologists to look with interest for the appearance of his revision of the Cestodes which has just been issued.[1] The letter of transmittal by the Chief of the Bureau calls attention to the importance of accurate knowledge as to specific limits, since "every separate species has a separate source of infection," and remarks truly that this paper "covers the results of a more thorough and extensive study of the tape-worms of cattle and sheep than has ever before been attempted."

Both authors are responsible for the bibliography and for the work on new species, Dr. Stiles, however, alone for the studies on species already known. The work is based on a careful and exhaustive study of internal anatomy, not only of our own forms, but also of the foreign species. In almost every instance the original types have been consulted with the result that now for the first time the character and limits of some of Rudolphi's species are known. In this connection the importance of preserving the type specimens cannot be too strongly emphasized. Dr. Stiles' experiments have shown that different methods of preservation result in such differences in external appearance and proportions, that no dependence can be placed on these data for specific determinations, the only safe generic and specific determinations are those based on internal anatomy. Careful study along this line has yielded unlooked for results. The topographical anatomy of the excretory system was shown in the preliminary already cited to be of great value in separating the genera in the family of the Tæniidæ and it forms the basis of the division employed in the present paper.

In the adult tape-worms of sheep and cattle, Dr. Stiles recognizes four genera:

---

[1] A Revision of the adult Cestodes of Cattle, Sheep, and allied animals. By C. W. Stiles, Ph. D., and Albert Hassall, M. R. C. V. S. U. S. Dept. of Agr., Bureau of Animal Industry, Bulletin No. 4, Washington, 1893; 103 pp., 16 plates.

I. Moniezia (Blanchard) which falls naturally into three groups:
   a. The Planissima group, with linear interproglottidal glands.
   b. The Expansa group with interproglottidal glands grouped around blind sacs.
   c. The Denticulata group, without interproglottidal glands.
2. Thysanosoma (Diesing), single uterus with ascon-shaped egg-sacs. Genital canals pass between longitudinal canals.
3. Stilesia (Railliet), for *Taenia globipunctata* and, provisionally, *T. centripunctata.*
4. Species inquirendæ.

In the special part of the genus Moniezia is considered first and most fully. Its three subgenera depend upon the presence and arrangement of the interproglottidal glands first described by Dr. Stiles. These are absent in one subgenus; in the second they form a deeply colored line in the stained specimen near the posterior edge of the proglottids, and finally in the third subgenus they are localized around blind sacs which open between the proglottids. For particulars of each species the original paper should be consulted; it gives under each a full synonomy with a valuable list of hosts and of the geographical distribution so far as known, a bibliography of the species, a historical review and a detailed account of the anatomy. This is followed by a specific diagnosis based on the anatomical description and a statement with regard to the collections in which type specimens may be found.

Among interesting details in the genus Moniezia may be mentioned that on the right side the vulva is ventral, the cirrus dorsal, while on the left the reverse position obtains. New are the species *M. planissima, M. trigonophora* and *M. oblongiceps.* The systematic position of *M. benedeni* and *M. Neumanni* does not seem to have been satisfactorily ascertained since the material at hand failed to yield good preparations; Dr. Stiles refers them, however, to the Planissima group.

By examining some of the original specimens from Rudolphi's collection, the exact limits of *M. expansa* (*Tænia exp. Rud.*) were determined. It is evident that most helminthologists have included more than one species in their descriptions. The old genus Thysanosoma (Dies.) is reestablished to include the form subsequently named by Diesing *Tænia fimbriata,* and *T. giardii* Riv. Of especial interest may be mentioned the presence of two transverse canals in *Th. actinoides.* The necessity of a new genus for *T. globipunctata* and *T. centripunctata* was pointed out by Stiles in his preliminary; meantime

Railliet had reached the same conclusion independently and formed for them the genus Stilesia. Its anatomy is discussed here.

Part IV, the discussion of species inquirendæ, is followed by a short half page on the life history, and two pages of general conclusions. Here is included a key for the determination of species. It is undoubtedly more difficult to use than those of Moniez or Neumann, and on that account will no doubt be criticized and perhaps disregarded by some; it is, however, more accurate and allows a determination of the species as well as the genus, which heretofore has not been possible. Part VII is a valuable compendium of species according to hosts with commendable cross references. In the addenda the fact of the gradual failure of the interproglottidal glands to stain as the material macerates, and the consequent possible identity of some species are discussed.

The bibliography given is very full and under each title is a word or two of valuable explanation. Yet it is on the whole the least satisfactory part of the paper. One could wish that the authors had used a better system of reference than by numbers; these differ of course in the bibliography of each species and in the general list, and the confusion could not but lead to mistakes. Had the year system been used, references would have been alike for all lists, and such an error as is noted on p. 32, where "my note (26)" refers actually to a book by Dewitz, would not have been possible. Apart from the system, however, some omissions are noted. Thus on p. 26, and again on p. 42, in the synonomy, Blainville is quoted "after Baird, 1853," but neither name can be found in the general or in the special bibliographical list. The same can be said of Mégnin p. 87. The habit of scattering references at the bottom of the page (p. 66), or through the text (p. 72), also seems open to criticism.

These are, however, but slight defects in a work which is on the whole so worthy of high praise. As the first scientific study of taxonomical helminthology which has been made in this country, is is fitting that it should have eminated from the zoologist of the Bureau ot Animal Industry. It is, to be sure, purely scientific work; but its practical and economic value are correctly insisted upon by the Chief of the Bureau in his letter of transmittal already quoted. The Bureau is to be congratulated also upon the general appearance of the bulletin and especially upon the sixteen fine plates which are the work of its artist, Mr. Haines.

The Bureau does great service in offering to museums and private collections well preserved specimens of these tape-worms in exchange.

Of equal value is the exhaustive card catalogue of parasites and hosts kept by the Bureau. It is freely at the disposal of scientific workers, and by means of it one can refer to a desired species or to the entire literature on any parasite. Such an undertaking would be impossible save in the great libraries of the world, among which those at Washington are rated. Any one who, like the reviewer, has had occasion to refer to this catalogue, will appreciate its value and will join in wishing that such work may be long continued under the patronage of our Department of Agriculture.

HENRY B. WARD.

Clark's Microscopical Methods.[2]—This volume is hardly up to the times, being apparently the production of a man ignorant of modern methods of microscopical research. Thus we note an utter absence of any reference to such fundamental matters as serial sections, staining on the slide, the use of any fixing and hardening reagents except alcohol. We meet continually sentences like this " It is to be understood that the somewhat complicated processes of imbedding in paraffin and colloidin are not recommended for general use." We can say the same of the book.

Dodge's Practical Biology.[3]—To the long list of laboratory guides, the new year adds another. Professor Dodge has had considerable experience in teaching both high school (Detroit) and college (Rochester Univ.) classes and this work is the outcome of his experience. It is, as its name indicates, a guide to biology. It takes up first, the biology of the cell, treating of unicellular organisms and cells from the tissues of higher forms and then later, not in the sandwich manner but in the sequence which most teachers would adopt, takes up first the animals and second the plants. The directions for laboratory work are well and carefully drawn, and, a point which we note with pleasure, the student is told what to look for, not what he will find. He cannot answer the questions without recourse to the specimens, while the absence of illustrations renders it impossible for him to copy the diagrams in the book. Not only is structure studied, but, to such extent as is possible with the average student and with average facilities, the physiology as well.

[2] Practical Methods in Microscopy, by Charles H. Clark. Boston, D. C. Heath & Co., 1894, 120 pp., XIV+219.

[3] Introduction to Elementary Practical Biology. A laboratory guide for high school and college students, by Charles Wright Dodge. New York, 1894. 120 pp., xxiii, 422.

Aside from some minor slips of no importance, our greatest criticism would be that the work goes too much into detail, calling the students attention as strongly to minute points without any morphological importance as to those facts more pregnant with meaning. This, of course, is a minor matter where the student has a good course of lectures to accompany the laboratory work. It would be even less objectionable were there good text-books to assist him, but, as yet, the zoological text-book is a matter for the future.

Excepting this matter of lack of perspective which the student will in most cases be troubled with, we like the work and we feel confident of its adoption in many schools.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Geology of the Antartic Continent.—So little is known of the Antarctic polar regions that the résumé of facts given by Dr. John Murray, in a recent address before the Royal Geographical Society is of especial interest. Dr. Murray believes that there is abundant evidence of true continental land within the Antarctic circle, equal if not surpassing in extent the continent of Australia. Ross reports gray granite in the neighborhood of Victoria Land, and Dr. Donald secured some Tertiary fossils from the Seymour Island. D'Urville found both granite and gneiss exposed on an island near Adélie Land, while Wilkes describes an iceberg in the same locality covered with clay, mud, gravel, stones and large boulders of red sandstone and basalt, 5 or 6 feet in diameter. During the Challenger expedition fragments of granite and quartz were dredged from the bottom of the sea at the fortieth parallel of south latitude and as the vessel proceeded toward the Antarctic circle these fragments of rocks increased in number until they together with mineral particles and mud derived from land made up the larger part of the deposit. These fragment consist of granites, quartziferous diorites, schistoid diorites, amphibolites, mica schists, grained quartzites, sandstones, a few fragments of compact limestone, and partially decomposed earthy shales. They are distinctly indicative of continental land, and were undoubtedly transported by icebergs from the South Polar regions.

Among the numerous maps used by Dr. Murray to illustrate his paper is one showing the oceanic deposits around the Antarctic continent. Near the Antarctic land are the terrigenous deposits made of detritus from the continent. Glauconite is found in the blue mud of this area. A little to the north, the bottom is covered with a pure white siliceous deposit, the Diatom Ooze. Still further to the north, where the Diatoms on the surface have been replaced by Foraminifera and Pteropods, the deposit is a pinkish-white Globigerina Ooze. In latitude about 40° S. the sea is about 3 miles in depth, and here the deposit is composed of a fine Red Clay, manganese nodules, zeolitic crystals, spherules of extra-terrestrial origin, thousands of sharks teeth, and the remains of Cetaceans. In this red clay area a trawl brought up in a single hand over 1500 sharks teeth, some of them not to be distinguished from the

specimens of Carcharodon, found in the Red Crag of England. (Geog. Journ., Jan., 1894.)

Intrusive Sandstone Dikes in Granite.—During the summer of 1893, a peculiar sandstone rock composed of worn quartz grains was discovered in the neighborhood of Pikes Peak in the western side of the narrow Manitou park basin of sedimentary rocks. This rock occurs as the filling of an extensive system of fissures in granite under circumstances indicating that the sand was forced into the fissures under great pressure. Mr. Whitman Cross discusses the origin of these Dikes without, however, coming to any definite conclusion. So far as he is aware no other occurrence of sandstone dikes in granite has ever been described. They may be compared with the remarkable occurrences in California described by Diller.[1] These latter, however, were in shales of a great sedimentary complex of Cretaceous age, and they were parallel to a system of jointing planes in the strata. Moreover, Diller noted that below the horizons occupied by the dikes there occurred sandstone strata of a composition identical with that of the dike-rocks. The very plausible theory presented by Diller was that the fissures represented by the dikes were formed by earthquake shock, and that the sand was injected as quick-sand into the fissures under hydrostatic pressure from unconsolidated water-bearing sand layers below.

The Colorado dikes are more difficult to explain than those of California in that the known facts do not indicate the source of the sand; yet the physical and mechanical facts do seem to show that the fissures of this dike complex were filled by a fine quick-sand injected from a source containing a large amount of homogeneous material. On the one hand, it is impossible to suppose that such a system of fissures, large and small, with their many intersections, could remain open to be filled by any slow process, and, on the other hand, it is equally impopossible to believe that the uniformity and purity of the material filling the fissures, varying from mere films on cleavage planes of orthoclase grains in the granite to dikes several hundred yards in width, could have resulted from infiltration.

It has been stated above that the belt of observed dikes lies adjacent and parallel to the Manitou park basin of sedimentary rocks, the principal element in which is the red sandstones and grits of the Carboniferus (?) or Trias (?). These beds are, however, of much coarser and more heterogeneous character than the dike-rock, and the observations made do not suggest that the proximity is anything more than accident-

---

[1] Sandstone Dikes, J. S. Diller: Bull. Geol. Soc. Am., Vol. I, 1889.

al. It is not known that the dikes are younger than the sedimentary, for they were nowhere found in contact. The strata of the basin are now seen at the same level with the dikes, but faulting and a synclinal fold have clearly lowered them with reference to the granite on either side. Finally, it is probable that the dikes are not limited to the vicinity of the sedimentary basin. Neither end of the belt containing the dikes was determined, and an observation by Professor G. H. Stone shows plainly that sandstone dikes do occur in the same general strike line far removed from any sedimentary rocks. (Bull. Geol. Soc. Am. Vol. 5, 1894.)

The Origin of the Vichy Mineral Waters.—M. Dollfus has been making a study of the geology of the environs of Vichy and comes to the following conclusions as to the origin of the celebrated medicinal water of that region.

The waters charged with soda derived from the decomposition of porphyry percolate the earth in contact with carboniferous conglomerates and the Culm strata flowing in a synclinal. When their downward course is checked by the granules or the micropegmatites which are impermeable, they reascend through the tertiary beds. Here their flow is partially impeded by the arkose beds which are topped by the Cusset Marls, and an immense water sheet is formed near the contact of these two formations. Atmospheric waters are here the important factors, and the carbonic acid gas with which they are charged becomes an active agent, displacing even the silicic acid of some of the feldspathic compounds. In short the alteration is set up at the surface; decomposition and kaolinization of the porphyrites goes on, under our eyes, at the surface, for, below we see compact, unaltered rocks, in which no chemical activity is apparent.

The origin of the carbonic acid is more difficult to explain. Since the atmospheric waters do not furnish a large enough supply, some of it, as well as the lime, must be derived from chalks of Vernet and the water-bearing marls of Cusset. The phorphyritic strata are limited around the Central Plateau; the presence of granite, covering of impervious clay, an abundance of lime, and all the peculiar series of conditions which are met with at Vichy and no where else, explain the formation of these peculiar mineral waters and their isolation in the midst of hydraulic basins of which the products are so very different. (Rev. Sci. Mars, 1894.)

Metamerism in the Skull of Primordial Palæozoic Fishes.—One of the most interesting of recent discoveries is that by Dr. J. V. Rohon[1] regarding the fossils fishes of the genera *Thyestes* and *Trematas-pis* from the upper Silurian strata of the island of Oesel. Both genera belong to the order Aspidocephali. In *Thyestes* the cartilaginous primordial cranium falls into two distinct regions, anterior and posterior, the former of which is bilaterally segmented, the latter not. On each side of the anterior region five segments are recognizable, the proximal being joined to the middle skull mass, the distal portions being discrete, more or less pointed and arched behind. In the region of the second and third segments is the median frontal organ, between the third and fourth is the well marked optic capsule, while the parietal organ is above the fifth segment and between it and the hinder region of the skull. The hinder portion, representing the occipital region, is in form much like the body portion of the skeleton. Ventrally to it are apparently the remains of gill arches. Labyrinth and jaw apparatus are not differentiated.

From these facts Rohon concludes that the Aspidocephali cannot belong to Cyclostomes, Selachians, Ganoids or Leptocardii. They must belong to a distinct subclass for which he proposes the name Protocephali. The paper is a preliminary one and the complete article with plates will be awaited with interest.—K.

Mr. Rohon does not explain what he understands by the term Aspidocephali. The genera Thyestes and Tremataspis have been hitherto included in the family Cephalaspidæ of the order Osteostraca of the subclass Ostracophori of the class Agnatha. M. Rohon's observations show that this systematic arrangement needs no modification, except that the genera Thyestes and Tremataspis must be separated as a family distinct from the Cephalaspidæ.—C.

The Auriferous Slates of the Sierra Nevada.—In a recently published paper, Mr. J. P. Smith reviews the opinions of previous writers as to the age of the auriferous slates of the Sierra Nevada, and after giving a brief statement of recent discoveries and determinations of fossils from the beds in question, embodies the results of his investigations in the following conclusions:

"The Auriferous slates are known to consist of Silurian, Carboniferous, Triassic and Jurassic strata."

"The Mariposa slates are of Upper Jurassic, probably lower Kimmeridge age."

---

[1] Zool Anzsiger XVII, p. 51, 1894.

"The uplift and metamorphism of the Sierra Nevada and of the Coast range occurred in late Jurassic time, before the deposition of the Cretaceous."

"Neumayer's theory of climatic zones cannot be applied with exactness to the Jura of California, which can be understood only by the study of the geographic provinces of that time." (Bull. Geol. Soc. Am. Vol. 5, 1894.)

Comparison of Jurassic and Upper Cretaceous Tritubercules.—In a paper on upper Cretaceous Mammals, Prof. Osborn makes the following comparison of the Laramie mammalian dentition with that of the earlier Purbeck, and of the later Puerco.

"In the Laramie the modern placental or marsupial dental formulæ are established—the teeth behind the canine are usually seven, and do not usually exceed eight. Marsh observes in one jaw what he considers five premolar alveoli. Second, out of the high crowned upper molars of the Jurassic, such as those of *Amblotherium* and *Spalacotherium*, a relatively low-crowned or bunodont tritubercular molar has been evolved; as this is a possible parent form of the ungulate and primate upper molars, it is an essentially Tertiary type. Third, the lower molars have evolved a broad talonid or heel, which in many cases presents three cusps, whereas in Jurassic types the talonid is a spur or a narrow simple basin. Fourth, the trigonid, which is always very elevated in the Jurassic types, sinks in some cases to the level of the Talonid—another modernization looking toward ungulate and primate ancestry."

"Two features make the Laramie fauna appear more ancient than the Puerco: first, the non-development of an internal cingulum, which is common in the Puerco; second, the entire absence of the hypocone, which is quite strong in some Puerco mammals. On the other hand, the upper and lower molars of Types represented in figs. F, G, I, Cl, respectively, are analogous to Ectoconus, Dissacus, Diacodon, aud Haploconus of the Puerco."

"The zoological affinities of this fauna are at present hard to determine. *Ptilodus* and *Meniscoëssus* are still provisionally referred with the Multituberculates to the Monotremes. *Thlæodon* exhibits a jaw without an angle, and with a surprising resemblance to that of *Polymastodon;* the jaw is certainly neither of the typical placental nor of the marsupial type; this animal may therefore be provisionally considered a trituberculate Monotreme."

"The placentals and marsupials, and the question whether one or both of these orders is represented in this fauna, is still unsettled. Not a single jaw has been found or reported sufficiently complete in the delicate region of the angle to determine positively its placental or marsupial structure. Portions of the jaws which are preserved indicate the presence of the marsupial type of inflection, while others point to distinct placental angulation." (Bull. Am. Mus. Nat. Hist., Vol. 5, 1893.)

Ancestors of the Tapir.—In describing two new species of Protapirus, *P. obliquidens* and *P. simplex,* from the Lower Miocene of Dakota, Messrs. Wortman and Earle take occasion to discuss the phylogeny of the Tapiridæ and thus summarize the points brought out by the descriptions:

"1. We consider the genus Systemodon as standing in ancestral relation to the Tapiridæ.

"2. *Isectolophus latidens* is probably the line leading to the true Tapirs.

"3. If further discovery shows that *I. annectens* has both the last two premolars as complex as the true molars, it must be removed from the main tapir line.

"The earliest member of the subfamily Tapirinæ, or true Tapirs, is found in the Phosphorites of France, there being a considerable interval between the latter formation and the Oreodon Beds of the White River Miocene.

"5. In contrast with the other Perissodactyla of the White River formation, the premolars of *Protapirus* have not assumed the complexity of the true molars.

"6. The foot structure of Protapirus is nearly as far advanced in its evolution as that of the existing American tapir." (Bull. Am. Mus. Nat. Hist., Aug., 1893.)

Geological News,—ARCHEAN—According to Prof. G. H. Williams, volcanic rocks are widely distributed through the crystalline belt of eastern North America. The writer limits the term *volcanic* to effusive or surface igneous rocks, in contrast to such as have solidified beneath the surface. The areas of these ancient volcanic rocks now known fall roughly in two parallel belts; the eastern embraces exposures in Newfoundland, Cape Breton, Nova Scotia, Bay of Fundy, Coast of Maine, Boston Basin and the central Carolinas; the western belt crosses the Eastern Townships and follows the Blue Ridge through Southern Penn-

sylvania, Maryland, Virginia, North Carolina to Georgia. (Journ. Geol., Vol. II, 1894.)

PALEOZOIC—A remarkably well preserved Lepidodendron from E'snost near Autun is described by M. B. Renault under the name *Lepidodendron esnostense.* The specimen shows the stem, leaves, fructification and roots. Attached to the rootlets are small ovoid bodies supposed by the author to be the eggs of an aquatic insect, to which he gives the name *Arthroon rochei.* These same bodies have been observed upon *L. rhodumnense,* found near Combres (Loire), and described by M. Renault some fifteen years ago. (Rev. Sci., Feb., 1894.)

Mr. J. M. Clarke reports the discovery of a perfect specimen of the extreme apex of an Orthoceras, showing the nature of the protoconch. The fossil was found in the Styliola limestone of the Genesee shales, on Canandaigua Lake, New York, in an association of species which represents the earliest appearance in North America of the fauna of *Goniatites intumescens* Beyrich. The specimen consists of the apical chamber, to which the protoconch is attached. The upper end of the specimen shows the first septum to be circular and with a central sipho. The lateral walls of the first chamber taper rapidly to the plane of conjunction with the protoconch, and its depth is about one half that of the latter. The protoconch itself is semi-ovoid in shape, and when pared with those of Orthoceras previously described or figured [in the shrunken condition] is of very large size. It shows no indication of shrinking and its distal extremity is perfectly smooth. The length of the entire specimen is .85 mm.; that of the protoconch, .60 mm.; and the diameter of the first septum 1 mm. (Am. Geol., Vol. XII, 1893.)

MESOZOIC.—From a study of the fossil mammalia of the Stonesfield slate, Mr. E. S. Goodrich concludes that the primitive mammalian molar was probable tritubercular, and that the triconodont type was derived from it by degeneracy, contrary to the views of Cope and Osborn who assume that the primitive mammalian molar was represented by a simple reptilian cone which subsequently acquired a cusp in front and behind giving the Triconodont type, from which the Tritubercular type was derived. (Quart. Journ. Micros. Sci., Vol. 35.)

Mr. R. Lydekker figures and describes a new carnivorous Dinosaur from the Oxford Clay of Peterborough. The specimen comprises the anterior and posterior extremities of the left ramus of the mandible, and represents one of the Thecodontosauridæ. Since it differs from the described genera by the marked deflection of the mandibular symphy-

sis, it is referred to a new genus, Sarcolestes, with the specific name leedsii. (Quart. Journ. Geol. Soc., 1893.)

CENOZOIC.—The British Museum has lately received an extinct skate from the Lower Tertiary Limestome near Cairo, Egypt. It is described by Mr. A. S. Woodward under the name *Mylobatis pentonii*. The specimen consists of the jaws, showing the dentition, which, according to the writer is the largest specimen of Mylisbotis dentition that has hitherto reached any museum. The maximum width of the disk of this extinct species is estimated at not less than five meters. (Proceeds. Zool. Soc. London, 1893.)

MINERALOGY AND PETROGRAPHY.[1]

The Eruptive Rocks of Cape Bonita, Cal.—The eruptive rocks forming the main mass of Cape Bonita, the northern Cape separating San Francisco from the Pacific Ocean, are spherical basalts and diabases, in addition to basic tuffs. The basalt is remarkable for the great spheroidal masses that characterise it. In many places the entire rock-mass is a closely packed aggregate of large bolster-like bodies, whose cross-section is approximately circular. These consist of a compact amygdaloidal rock, made up of lath-shaped plagioclases lying in a glassy base. In all cases the rock of the spheroids is much altered, and is of the same composition in the interiors as on the peripheries of the bodies. In a few cases augite may be detected as small grains that are younger than the plagioclases, but the rock on the whole is very uniform in character. The diabase is more interesting petrographically. It is younger than the basalt and has intruded this rock. Besides the usual constituents of diabase it contains iddingsite in large, rounded, idiomorphic forms. The augite varies in color from nearly colorless to a deep violet red, the latter varieties possessing a pleochroism in yellowish green and violet red tints. A qualitative test showed the presence of titanium. Sometimes the augites of different colors are intergrown, when they are optically continuous, and not infrequently the mineral is intergrown with brown hornblende. The outlines of the iddingsite are strongly suggestive of olivine. It was one of the earliest separations from the magma, being included in the augite and in the hornblende. Its own enclosures are magnetite and chromite or picotite. In some phases of the rock both green and brown hornblende are present. Both of these are regarded as original and as of the same age as the augite, for they are frequently intergrown with the pyroxene as well as with each other. In one place the diabase is variolitic, with variolites composed of tiny brushes and crystallites of various minerals, lying in a microlitic diabasic groundmass. Iddingsite occurs both in the groundmass and in the varioles. The pyroclastic rock associated with the basalt and the diabase is probably an ash of a basaltic character. Some of its component fragments resemble closely the material of the spheroidal rock. Analyses of the rocks discussed are given by Mr. Ransome,[2] in a recent number of the University of California Bulletin.

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Bull. Geol. Dept. Univ. Cal., Vol. 1, p. 71.

Lamprophyres near the Shap Granite Mass.—Near the Shap granite in the North of England there are numerous dykes of minette and kersantite that are believed by Harker[3] to be the dyke facies of the granite, just as fourchite and ouachitite are regarded by Rosenbusch as dyke facies of eleolite-syenite. These lamprophyres contain many rounded blebs of quartz and corroded crystals of orthoclase, both of which appear to owe their present shapes to resorption processes, since both minerals are surrounded by resorption borders. The dyke rocks are thought to be genetically connected with the granite because of their age and distribution, and because of the fact that they contain the quartz and orthoclase above referred to, and also sphene, which is a characteristic component of the granite. A study of the literature of the lamprophyres shows that these rocks are often associated with granites, and hence Harker believes that the group may be discovered to be genetically related to this group of plutonic rocks. A special feature of the lamprophyres pointed out by the author is that while the total alkalies in them is about equal in amount to the sum of the alkalies in the associated granite, the potash in the former always bears a larger ratio to the soda than it does in the latter rock. It is suggested that the granite and the lamprophyres are portions of the same magma that became differentiated by gravity. From the supernatant layer, which was acid, quartz and orthoclase separated and then settled down into the lower basic portions of the mass. These were then partially dissolved, the solution of the orthoclase accounting for the large proportion of potash in the lamprophyres. In a later paper the author[4] argues against the view of Diller and Iddings that the sporadic quartzes in certain basalts and other basic rocks are the result of crystallization under other than the normal conditions. He thinks that in all these cases the quartz may have originated as outlined above.

The Geology of Conanicut Island, R. I.—The carboniferous phyllites of Conanicut Island in Narragansett Bay are cut by a mass of coarse-grained muscovite granite porphyry that has produced contact effects in the surrounding sedmentaries.[5] The granite, which exhibits many evidences of its intrusive nature, was regarded by Dale[6] as a metamorposed clastic rock, forming the lowest member of the bedded series at this place. The phyllites near the contact with the granites

---

[3] Geol. Magazine, 1892, IX, p. 199.

[4] Ib. IX, p. 485.

[5] L. V. Pirsson. Amer. Jour. Sci., 1893, XLVI, p. 363.

[6] Proc. Bos. Soc. Nat. Hist., 1883, XXII, p. 179.

have been changed into hornstones and knotty schists. Besides the granites the only other intrusives cutting the slates are two dykes of minette, both of which show the effects of pressure. One of the dykes consists essentially of orthoclase and two generations of biotite. It contains also apatite and zircon and large quantities of plagioclase and calcite. In the squeezed phase of the rock the biotite has been changed to chlorite. The material of the second dyke differs from that of the first one, only in that it has been more thoroughly squeezed and consequently has suffered greater alteration.

Petrographical News.—Sears[7] finds that the porphyritic feldspar in the rock from Marblehead Neck, Mass., called by Wadsworth[8] trachyte, are anorthoclases, and that much of the feldspar of its groundmass is of the same nature, consequently the rock is a keratophyre. Analyses of the rock and of one of its phenocrysts follow:

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	H_2O
Rock	70.23	.03(?)	15.00	1.99		.24	.33	.38	4.99	4.98	.06	2.19
Felds.	65.66		20.05	tr.	tr.	.13	.67	.18	6.98	6.56		.41

The report of the State Geological Board of Michigan[9] contains brief microscopic descriptions of certain eruptive, sedimentary and schistose rocks of the Upper Peninsula by Drs. Patton and Lane. Among the former are described granites, syenites, serpentine and lamprophyres. Among the sedimentaries graywackes, quartzites and slates, and, among the foliated rocks, amphibolites and hornblende schists. The amphibolites are principally altered diabases. Quartz diabases are mentioned by Lane as existing in dykes cutting graywackes and slates that are sometimes changed on the contact into spilosites, and quartzites that are altered near the intrusive into Lydian stone. Dr. Wadsworth, in the same volume, gives an outline scheme of his classification of rocks (eruptive and sedimentary), the principles of which were first ennunciated at length in his Lithological Studies.[10]

Graeff[11] has found, in an old hand specimen of tephrite from Horberig in the Kaiserstuhl, a holocrystalline basic concretion with a structure approaching that of theralite.

---

[7] Bull. Mus. Comp. Zool., Vol. XVI, p. 167.

[8] Proc. Bost. Soc. Nat. Hist., XXI, p. 288.

[9] Rep. State Board of Geol. Survey for 1891-92. Lansing, 1893.

[10] Mem. Mus. Comp. Zool., 1884, XI.

[11] Versamm. Oberrh. Geol. Ver. Ber., XXVI, 1893.

A modification of the microchemical method for determining iron in minerals is given by Lemberg.[12] It consists in producing Turnbull's blue from the ferrous sulphide precipitated on the mineral in question.

Alurgite and Violan from St. Marcel.—Among the minerals from the Manganese mines of St. Marcel, Piedmont, *alurgite* and *violan* have always excited considerable interest because of their rich color and their variety. The alurgite was described by Breithaupt as a deep red mica. Penfield[13] has recently obtained a sufficient quantity of the material for study. He describes it as monoclinic in crystallization and micaceous in habit. Its cleavage plates are flexible and somewhat elastic. It is biaxial with $2\ E_{na} = 56° 32'$ (average) and its dispersion is $\rho > v$, but often plates show a uniaxial optical figure, due, as the author supposes, to twinning. The mica is one of the first order, and in spite of its dark color, its pleochroism is very slight. Density = 2.835—2.849. H = 3. Composition:

SiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	MnO	MgO	K_2O	Na_2O	H_2O	Total
53.22	21.19	1.22	.87	.18	6.02	11.20	.34	5.75	= 99.99

In the formula $H\ R_2\ (Al\ OH)\ Al\ Si_4O_{12}$, R = K and Mg OH. Alurgite is thus a distinct species, which is more nearly allied to lepidolite than to muscovite, although it is a potash mica. The alurgite is associated with a jadeite composed largely of a soda-rich pyroxene that is pleochroic in pale rose and pale blue tints. Its density is 3.257—3.382, and composition (mean of two analyses):

SiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	MnO	MgO	Ca_2O	Na_2O	K_2O	Ign	Total
54.59	9.74	11.99	1.06	.58	5.03	7.24	9.32	.24	.37	=100.16

corresponding to $Na\ R(SiO_3)_2$ in which R = Al, Fe‴, Mn‴. The mineral occupies about the same position in the pyroxene group as glaucophane does among the amphiboles. In composition it agrees most closely with the chloromelanite from Mexico analysed by Damour.[14]

For purposes of comparison with this pyroxene, the author analysed a specimen of violan whose density was 3.272 — 3.237, with this result.

SiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	MnO	MgO	CaO	Mn_2O	K_2O	Ign	Total
53.94	1.00	.86	.88	.36	16.63	23.80	1.22	.05	.66	= 99.44

The figures indicate a mixture of the diopside, jadeite and acmite mole-

---

[12] Zeits d. deuts. geol. Ges., 1892, p. 823.

[13] S. L. Penfield. Amer. Jour. Sci. XLVI, p. 288.

[14] Bull. Soc. Min. d. Franc, IV, 1881, p. 157. Cf. also foot-note No. 30.

cules in the proportions 90.8 : 4.1 : 2.4, with the addition of 2.7% of the molecule Na Mn $(SiO_3)_2$. The mineral is essentially a blue variety of diopside, differing from the anthochroite of Igelström[15] and from the blue pyroxene of Merrill and Packard.[16]

Zonal Plagioclase.—Herz[17] has shown by a study of the position of axial planes in successive zones of zonal plagioclase, and by the values of the respective cleavage angles, that the zonal banding in this mineral is due to the concentric growth of envelopes of different composition. The axial planes and the cleavage angles always correspond with the extinction angles in the corresponding band. It had been suggested by Grosser that the regular decrease in the extinction of the shells of a zonal plagioclase is due to difference in the orientation of the successive envelopes and not to a difference in their chemical composition. Herz's work proves conclusively that the decrease in the value of the extinction is not due to differences in orientation of the same chemical substance.

Hercynite in Gabbro.—Small octahedra and large irregular masses of the green spinel hercynite occur in an altered gabbro at Le-Prese, in the Valtellina, Switzerland. According to Linck,[18] it is found as irregular granular masses within the rock, and as small octahedral crystals enclosed in its plagioclase and associated with corundum sillimanite and biotite. The spinel includes small quantities of biotite, small plates of ilmenite, resembling the plates in hypersthene, a little pyrite, etc. An analysis of tolerably pure material yielded:

SiO_2	Al_2O_3	Fe_2O_3	MgO	FeO		Total
1.59	59.62	3.10	9.38	25.30	=	98.99

which corresponds to (Fe Mg) Al_2O_4 in which Fe : Mg = 3 : 2.

Optical Constants of Topaz.—Four Japanese topaz crystals and one crystal of the same mineral from New South Wales are described by Hahn,[19] and some of the optical constants of the former have been determined. One of the crystals from Otamjama near

---

[15] AMERICAN NATURALIST, 1890, p. 74.

[16] Ib., 1892. p. 848.

[17] Min. u. Petrog. Mitth. XIII, p. 341.

[18] Sitzb. d. Kön-preuss. Akad. d. Wiss. zu Berlin. Phys.-Math.-Classe., 1893, p. 47.

[19] Zeits. f. Kryst., XXI, p. 334.

Kioto, has the following refractive indices and optical angles for yellow light: $\beta = 1.6182$, $\gamma = 1.6252$, $2\,V = 62° 40'$, $2\,E = 114° 31'$. The crystal from New South Wales has $2\,E = 113° 18'$.

Mineralogical News.—Stöver announces the discovery of fine *celestites* in the Jurassic schists of Brousseval in France. Their axial ratio is .7803 : 1 : 1.2826, and index of refraction for sodium light = 1.6235. The crystals are one centimeter in length, and are elongated parallel to $\breve{a}$. Similarly habited crystals occur also in the marl of Ville-sur-Sault. The axial ratio of these is .7806 : 1 : 1.2797, and density = 3.991.

Rheineck[20] has made another attempt to calculate from the published analyses general formulas for *tourmaline* that will not only represent the composition of all varieties of the mineral, but which will also express its relationship with micas. He concludes that there are two alkaline varieties, viz.: $Al_4\,Si_3\,B\,H_3O_{15}$ and $Al_4\,Si_3\,B_2\,H_4\,O_{17}$, and two magnesium varieties, $Al_4\,Si_5\,B_2\,Mg_4O_{25}$ and $Al_4\,Si_5\,B_2\,Mg_3\,O_{22}$, by whose intermingling all other varieties are formed.

Several crystallographic observations of Baumhauer[21] are of interest. A yellow *diopside* from the Canton of Graubünden (Grisons), Switzerland, has an axial ratio $a : b : c = 1.0918 : 1 : .5879$, with $\beta = 74° 12' 15''$. *Binnite* crystals from Infeld in the Binnenthal are certainly tetartohedrally hemihedral, as the author has succeeded in finding upon them, well-developed, the planes $\frac{O}{2}$ and $\frac{2O2}{2}$.

Oebbecke[22] mentions the occurrence of *topaz* with feldspar, apatite, tourmaline, fluorite, etc, at Epprechtstein and its existence in the granite of the Gregnitzgrund in the Fichtelgebirge.

The *arsenopyrite* of Weiler in Alsace occurs in an arkose from which Scherer[23] has obtained crystals sufficiently large for measurement and analysis. These crystals are prismatic in habit, and have an axial ratio $a : b : c = .6734 : 1 : 1.1847$. A mean of two analyses gave figures corresponding to Fe : S : As = 1 : .9933 : .9751.

Mallard[24] has come into the possession of some beautiful little crystals of *periclase* that were found implanted on a white compact crust produced in the culcination of some of the Stassfurt materials.

Several twins of *aragonite* from the tunnel of Neussargues in Cantal,

---

[20] Zeits. f. Kryst., XXII, p. 52.

[21] Ib., XXI, p. 200.

[22] Ib., XXII, p. 273.

[23] Ib., XXII, p. 62.

[24] Bull. Soc. Franc. Min., XVI, p. 18.

France, are reported by Gonnard[25], and some fine crystals of *pinite*[26] from Issertaux, near St. Pardoux in the Auvergne.

Miscellaneous.—In his development of the theory of the constitution of the *micas*, Clarke[27] has reached the problem of the lithium members of the group. This he solves by supposing lepidolite to be an admixture of the simple molecules $Al\ F_2\ Si_3\ O_8\ R_3'$, in which R′ is principally lithium, and $Al_3\ (SiO_4)_3\ R_3'$, in which R_3' may be either K_2H or KH_2.

Retgers[28] suggests molten phosphorus and a solution of phosphorus in CS_2 as media for use in determining the indices of refraction in highly refracting substances. A tiny fragment of the phosphorus may be melted between two object-glasses, when it spreads as a thin sheet between them, and, upon cooling, remains transparent. Its refractive index is 2.144. That of a saturated solution of the substance in CS_2 is 1.95.

Some time ago, Damour[29] suggested the name *chloromelanite* for one of the varieties of jade found in ancient implements. He discovers now that the material contains garnets and pyroxene. It thus resembles the rock eclogite. The pyroxene from a Mexican specimen is composed as follows:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O		Total	Sp. Gr.
56.57	17.21	8.86	4.44	2.12	10.70	=	99.90	3.37

Nordenskjöld[30] has begun the study of snow crystals. The first contribution to his discussion is a series of handsome photographs of a large variety of flakes, including prismatic, stellar and other forms some of which contained liquid enclosures at the time of their fall.

[25] Ib., XVI, p. 10.

[26] Ib., XVI, p. 16.

[27] Bull. Am. Chem. Soc., XV, May, 1893.

[28] Neues Jahrb. f. Min., etc., 1893, II, p. 130.

[29] Bull. Soc. Franc. Min., XVI, p. 57. Cf. also foot-note No. 14.

[30] Ib., XVI, p. 59.

BOTANY.[1]

What is Mycoderma ?—1. In my papers on the yeasts, I have mentioned the doubtful position of the sprouting fungus *Mycoderma* which morphologically and systematically stands near to the *Saccharomycetaceae.* From the latter, it is easily distinguished on account of its high refractive power, the cells being also rectangular, not spore-bearing, and very apt to aggregate in masses, or in a film. When beer, wine, or other sugar-containing liquids are exposed to the air, the *Mycoderma* will very soon form a gray, greasy looking, uneven film on the surface of the liquid. Hitherto, it was supposed that this fungus could not form alcohol; Lasché has, however, found four species which yield ¼ to 2½ vol % of alcohol (See Der Braumeister, Chicago, 1891, No. 7); Winogradsky found that the morphology of the cells changes according to the amount of organic material given in a constant solution of inorganic nutritive matter. (See Centralbl. f. Bakteriol. u. Paras., 1884, p. 164). Lately, F. Lafar showed that at least one species will produce acetic acid. (Ibid, XIII, p. 684–697 1893, w. pl.).

In 1879 Hansen expressed his opinion that there were undoubtedly more than the two species—*M. cerevisiae* and *M. vini*—described by Pasteur (Studies on fermentation, pp. 77, 110, pl. IV) in existence. These two named species cannot be distinguished from each other, and they must be regarded as synonyms to all the species—at present 7—known. The macroscopic appearance of these fungi was mentioned in the January No. of the *American Monthly Microscopical Journal.*

2. The name *Mycoderma* was given by Pasteur to the bacterium of acetic fermentation. As far back as 1834, Kützing determined the vegetable nature of this ferment; he named it *Ulvina aceti.* Pasteur (See Etudes sur la vinaigre) and Turpin took the question up again, and studied the morphology of the organism. In 1879, Hansen found a new species which assumes a blue color with iodine or IKa., while the other species became yellow when thus treated. He found, lately, still another species which is also colored blue with iodine, namely, the species *kützingianum.* The genus–name was, on the suggestion of Zopf, changed into *Bacterium.* (See Berichte der Deutschen Botanischen Gesellschaft, 1893, p. (69–73). Three species of acetic fermentation

---

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska,

bacteria are thus known at present, namely, (1) *Bacterium aceti* (Kütz.) Zopf, (2) *B. pasteurianum* Hansen, and (3) *B. kützingianum* Hansen. The cardinal temperatures are: Minimum for (1), 4°–5° C; for (2), 5°–6° C. Maximum is for all of them 42°–43° C, and optimum 34° C.

Morphologically, these species consist of (1) long cells, (2) swollen cells, and (3) chains of short bacula. By 40° C–40°, 5 C pure cultures were in good development, during which some of the cells of the chains grew very long, and in twenty-four hours, there was a typical vegetation of long cells, totally different from the original culture. If this new culture is exposed to a temperature of 34° C, the original chains are again formed. The long cells measured 200μ and more; by 34° C; they first swell in one or more places, sometimes assuming ball shape (diam. 11μ), then they are divided into typical chains. Nägeli regarded the long and the swollen cells as abnormal forms.

When we speak of the influence of outward agencies upon the life-activity of organisms like those mentioned above, we have generally described the influence in its action only upon *one feature* of such activity. It is not at all sure that the cardinal temperatures of *fermentation* are identical with those of the *life* of the yeast, or with those of the *cell-division* or *spore formation* of the latter. We know that the cardinal temperatures of germination, transpiration, respiration, assimilation, geotropism, heliotropism, hydrotropism, rheotropism, etc., etc., in "higher" plants are not always identical. In the instance mentioned above, we see that the *cell-division* has its cardinal temperatures, a conclusion which we may draw from the observations. We further see that bacteria are more polymorphus than is suspected, and that a new road is open for investigation which doubtless will tend to broaden our knowledge of microörganisms and of many important physiological questions.

J. Christian Bay.

The so-called "Russian Thistle."—It is the fate of few weeds to reach so suddenly such great notoriety as that recently attained by *Salsola kali* L. var. *tragus* DC., the so-called "Russian Thistle." If one turns to any of the botanical manuals he finds no plant under this common name. He will find the "Common Saltwort." of the "sandy shore, New England to Georgia" described in such mild terms as to give no idea of the weed as it appears to the farmer upon the western plains.

The species is a native of mountainous regions in both hemispheres.

In Europe it occurs from Spain to France, Belgium, Holland, Great Britain, Ireland, Denmark, Norway and Sweden, and along the Mediterranean coast of France, Italy, Greece and Turkey. Even the sandy tracts of interior countries are not free from it; thus it is found in Germany, Austria, Hungary and Russia. It occurs also in temperate Asia. In America as stated above, it extends from New England to Georgia. The variety is apparently much less widely distributed, but the exact limits of its geographical range are not well defined, most recent authors not regarding it as sufficiently distinct to warrant separate treatment.

The technical description of the variety (to which alone the name Russian Thistle is applied) as drawn up by L. H. Dewey of the United States Department of Agriculture, is as follows:

"*Salsola kali* L. var. *tragus* DC. Prod. XIII, 2, 187 (1849). Herbaceous, annual, diffusely branching from the base, usually densely bushy at maturity, .5 to 1 m. high and twice as broad, smooth or slightly hispid; root simple, dull white, slightly twisted near the apex; leaves alternate, sessile; of the young plant deciduous, succulent, linear or subterete, 3 to 6 cm. long, spiny-pointed, and with narrow, denticulate, membranaceous margins near the base; leaves of mature plant peristent, each subtending two leaf-like bracts and a flower, at intervals of 2 to 10 mm., rigid, narrowly ovate, often denticulate near the base, spiny-pointed, usually striped with red like the branches, 6 to 10 mm. long; bracts divergent, like the leaves in size and in all respects but position; flowers solitary and sessile, perfect, apetalous, about 10 mm. in diameter; calyx membranaceous, persistent, enclosing the depressed fruit, usually rose colored, gamosepalous, cleft nearly to the base into five unequal divisions about 4 mm. long, the upper one broadest, the two next the subtending leaf next in size and the lateral ones narrow, each with a beak-like, connivent apex, and bearing midway on the back a membranaceous, striate, erose-margined wing about 3 mm. long, the upper and two lower ones much broader than the lateral ones; stamens 5, about equalling the calyx-lobes; pistil simple; styles 2, slender, about 1 mm. long; seed 1, obconical, depressed, about 2 mm. in diameter, dull gray or green, exalbuminous, the thin seed-coat closely covering the spirally-coiled embryo; embryo about 12 mm. long with 2 terete cotyledons."[1]

Salsola is one of the prominent genera of the family *Chenopodiaceæ*, and is the most important member of the tribe *Salsoleæ*. Its forty spe-

---

[1] Bulletin 31, Agricultural Experiment Station of the University of Nebraska, Dec. 1893.

cies are very widely distributed in Europe, Asia, North and South Africa, America and Australia.

The Russian Thistle appears to have come to this country in flaxseed imported directly from Europe to South Dakota seventeen or eighteen years ago. For a while it was popularly supposed that the Russian settlers in South Dakota had purposely brought it for use as a forage plant, but this is now generally discredited. The name "Russian Thistle" is, however, so well fixed that it will continue to be used in spite of its inappropriateness, just as we say "Canada Thistle" for another Old World weed.

For a number years after its introduction it attracted little attention, and it was not until seven or eight years ago (1886) that it began to be troublesome in South Dakota. Since this time it has spread with much rapidity. Both of the Dakotas are now badly overrun with it. A few years ago it invaded Nebraska, coming into the State about Valentine, and in Knox, Cedar and Dixon Counties. It probably came to the first named place with the United States soldiers stationed at Ft. Niobrara, a few miles east of the town of Valentine. The frequent transfers of troops from forts in South Dakota afford ready means of transportation to weeds of this nature. For several years it has been spreading from this point. The counties mentioned are separated from South Dakota by the Missouri River, but here and there are ferries over which teams frequently pass, and at these points the Russian Thistles are very abundant.

The railroads have aided materially in their distribution, as is shown by the fact that by the end of 1893, Russian Thistles were to be found in nearly all parts of Nebraska, and in nearly all cases they were at first confined to a narrow belt along the track. Year by year they spread from this belt, moving most rapidly along the lines of greatest travel. The wind, also, is an efficient agent in spreading them, since in many cases, the nearly spherical plants are broken off at the root, and rolled for long distances as "tumbleweeds," scattering their seeds throughout their course.

In Minnesota, Iowa and Wisconsin, Russian Thistles have appeared, and here again they have been brought in by the railroads. The reason why the railroads have had so much to do with the distribution of this weed, is that finding by the side of the tracks much unsodded ground, they spring up here in great numbers, and in the fall when they break off by the winds they are caught up the passing trains and carried away on the trucks or steps of the cars or on the pilot or in the machinery of the engine.

The states of the Plains, the Dakotas and Nebraska, and those next adjacent, have taken steps to warn their people of this invading weed by bulletins and through the public press. The United States Department of Agriculture sent an agent to inspect the invaded region, and issued a special bulletin on the subject. The Russian Thistle is a common topic for papers and discussions before Agricultural and Horticultural Societies, farmer's institutes, farmer's clubs, alliance meetings, etc. It will soon be so well known upon the Plains that it will no longer be allowed to grow unmolested because unrecognized.

CHARLES E. BESSEY.

ZOOLOGY.

Reproduction of the Foraminifera.—Fritz Schaudinn has studied this little known subject and presents[1] these results: The reproduction is effected by the division of the protoplasm into, in different individuals, a varying number of pieces which secrete shells and grow into the adult after different methods according to the species. The following modifications of the process are noted:

I. The division of the protoplasm, the assumption of form, and the secretion of the shell by the pieces is completed within the shell of the mother. The embryos then leave the mother either, through the mouth, or, when that is too small, by a breaking through the shell. II. The division occurs inside the mother shell and the embryos escape as naked plasmodia, to develop the shell outside. III. The protoplasm leaves the mother shell as a connected mass and all processes occur outside the old shell. In all cases the mother, before reproduction, is polynucleate, the embryos are usually uninucleate but in some cases 2 or 3 and rarely more nuclei are present.

Schaudinn further calls attention to a peculiar type of nuclear multiplication which he finds common in this group but which has hitherto escaped notice. He has never seen division into two daughter nuclei, but in all forms studied, after a series of changes the mother nucleus divides into many daughter nuclei. Briefly summarized these changes are as follows: Through the absorption of fluid the homogeneous mother nucleus becomes vesicular and then inside this, by means of an achromatic filament apparatus, an equal division of the whole nuclear substance (chromatin and achromatin) into numerous portions follows, and these by disappearance of the nuclear membrane pass freely into the cytoplasm and become independent nuclei.

Regeneration in Hydroids.—Dr. C. B. Davenport attacks[2] one aspect of the problem of regeneration. One of the fundamental assumptions of theories of heredity is that regeneration, like development from the egg depends upon the pre-existence of embryonic tissue but a disputed point is whether embryonic tissue is qualitatively different in different parts of the body, *i. e.*, whether it can produce only certain definite and distinct things or whether it is potentially the same

[1] Biol. Cblt. XIV, 163, 1894.

[2] Anat. Anzeiger IX, 283, 1884.

and the different results depend on agencies outside the developing cells. This he applies to the regeneration of lost parts in Obelia, by by cutting off the hydranths and their stalks at different levels. His conclusions are:

"First. The regenerative tissue is not differentiated at different levels to produce different things independent of environment; but on the contrary, the embryonic tissue at all levels may produce the same things.

"Second. Wholly aside from the production of definite things, there may be acquired in certain embryonic tissues a usual method of development, independent of environment. * *

"Third. The curves of regeneration bring out a second wholly unexpected series of facts; namely, the tendency of regenerative tissue at all levels to produce preferably certain forms. * * * "

Closely allied to these observations of Davenport are some by Albert Lang[3] who, working under the direction of Professor Weismann, claims that in certain hydroids, notably in Hydra, Eudendrium and Plumularia, both germ layers do not participate in the formation of the buds but that these structures proceed from the ectoderm alone which by a sort of multipolar gastrulation forms the entoderm of the bud, and is to be regarded as the sole foundation of the daughter individual. Accompanying this paper is a note by Prof. Weismann stating that the facts observed by Lang were just such as he had predicted upon theoretical grounds.

Shortly after the publication of Lang's results, his experiments were gone over by an American student who found that while he could easily duplicate Lang's figures, the conclusions based upon them were due to errors of misinterpretation and that in reality both layers do participate in the bud formation. These results have not been published. This is, however, the less to be regretted since Dr. F. Braem of Breslau has recently gone over the whole matter and he announces[4] that Lang's account is all wrong. He finds nothing which will support Lang's conclusions, there is no fusion of one germ layer with the other and never a proliferation of cells of the ectoderm of the parent to form the entoderm of the adult.

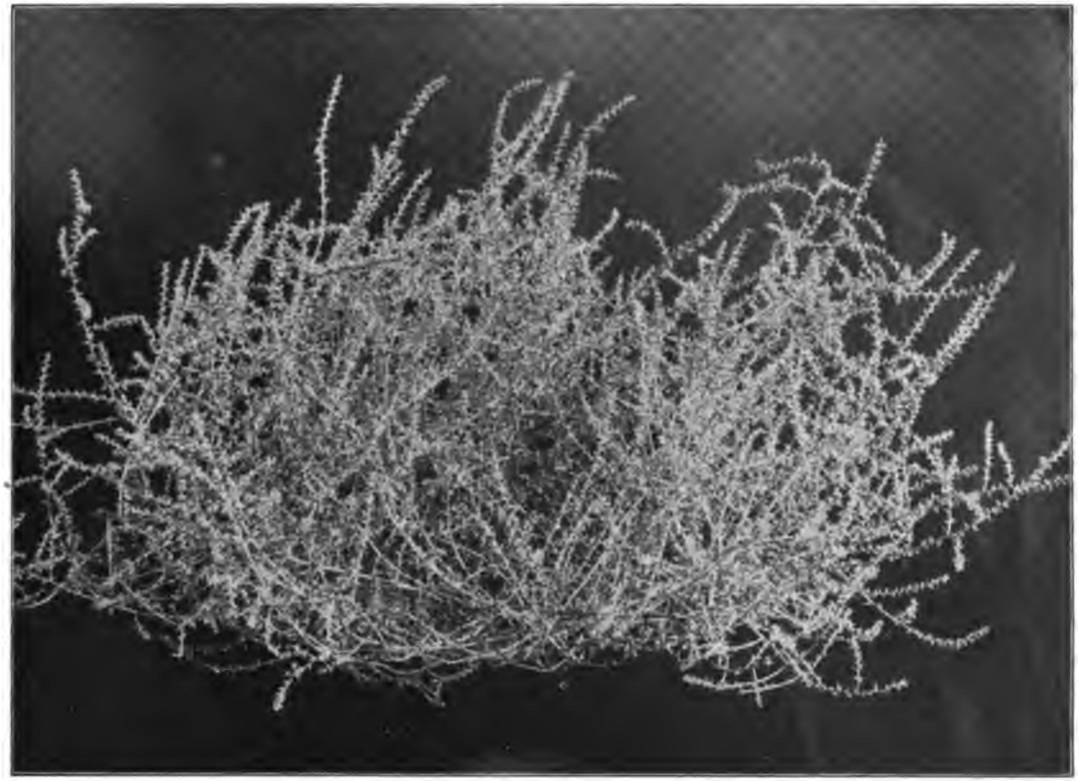
The Parietal Eyes.—Those who have kept close watch of the progress of our knowledge of the "pineal gland" can but be interested in some recent papers. Long believed to be a gland and by

---

[3] Zeitsch. f. wiss. Zool. LIV, 365, 1892.

[4] Biol. Cblt. XIV, 140, 1894.

PLATE X.



Russian Thistle, about one-sixth natural size, from one of the streets bordering the city park of Lincoln, Nebraska.

Descartes assigned as a proper sized organ for the residence of the soul, this structure was first pointed out by de Graaf and Spencer, almost simultaneously, as a veritable visual organ in process of disappearance. After their papers the literature of the organ grew rapidly until the veteran histologist, Leydig, announced that it was not an eye; and since he had been the first to suggest that the structure was sensory his final dictum, finely illustrated, naturally had weight. Then Beranek showed that there were two organs confused, an anterior eye and a posterior vascular or glandular structure. The two recent papers to which we have referred throw no little light upon the matter. Prof. W. A. Locy has described[5] the early phases of the eye in the Selachians and he further shows that the early optic pits are but one of three serially homologous pairs of structures which differ in their early stages only in the matter of size. The posterior pairs are traced into the optic outgrowth. In the second paper Klinckowström[6] gives a number of facts regarding the structure of the parietal organs in the South American Iguana and Tejus which in connection with the work of Locy and Beranek tempt one to indulge in speculation. With what Klinckowström has to say of the parietal eye proper we have little to do. It is rather with the secondary structures. There are in Iguana two distinct phases to the epiphysial outgrowth. In the first the parietal eye proper is cut off from its connection with the cerebral cavity thus forming the eye and the epiphysis. Next, the distal portion of the epiphysis takes on a histological character closely approaching that of the parietal eye, the deeper portion retaining its former conditions, and a constriction tends to separate this from the rest. Klinckowström naturally considers this as the temporary appearance of a second epiphysial eye. In connection with Locy's observations and especially when taken in connection with Klinckowström's further observation that there is a second nerve developed in position for this outgrowth, the conclusion is inevitable that the ancestor of the vertebrates had not three eyes but at least three pairs of eyes. As is well known the parietal nerve is not median but on one side. In some cases he found one on either side, showing that the lack of symmetry is due to a failure to develop on the part of one of the nerves. One of Klinckowström's conclusions seems a little questionable. He concludes that the parietal nerve is not strictly comparable to the optic nerve, the point apparently being that in the one case the nerve follows the optic outgrowth while the parietal nerve does not,

---

[5] Jour. Morphol. IX, 115, 1894. See also Anat. Anzeiger.

[6] Zool. Jahrb. Abth. Anat. VII, 249, 1894.

but enters the roof of the brain in the region of the habenular ganglion. This difference does not strike one as forcibly as a little while ago. The recent investigations of Keibel and Assheton have shown that the optic stalk is not the optic nerve, but this stalk merely forms the tract through which the true nervous elements grow inward from the retinal layer. This being the case it is easy to see that possibly in the case of the parietal nerve the outgrowth has been through other tissue.

East African Reptiles and Batrachia.—The U. S. National Museum has recently received some valuable collections of Reptiles and Batrachia from Eastern Africa and the adjacent islands and these have now been studied by Dr. L. Stejneger.[7] Among the interesting facts brought out is a better knowledge of the fauna of the Seychelles. Wallace, in his "Island Life," enumerates 11 species as found in these islands of which five are considered as peculiar to them. To-day, fifteen species of Reptiles and Batrachia are known with certainty, plus several more doubtful, as coming from these Islands and of these ten are not known from any other locality. Ten of these species are represented in the museum collections. The new species described in this paper are *Diplodactylus inexpectatus* (Seychelles), *Phelsuma abbotti* (Aldabra), *Eremias sextæniata* and *E. hoehnelii* (Tana River, E. Af.), *Mabuya chanlerii* (Tana R.), *Ablepharus gloriosus* (Gloriosa Is.), *Typhlops mandensis* (Manda Is.), *Simocephalus chanlerii* (Manda), *Causus nasalis* (West Africa), *Hypogeophis alternans* (Seychelles).

On the Iguanian genus Uma Baird.—This genus has been hitherto represented by but two specimens, and has been hence but little known. Professor Baird in his original description in 1852 did not adduce any character sufficient to distinguish it from Callisaurus Blv., and it was not until 1866 that I pointed out that the difference consists in the possession by Uma of a series of elongate free scales on each side of the digits, and on the external side of the sole, which are wanting from Callisaurus. I noted the occurrence of the genus near Tucson, Arizona, as represented by a second and adult individual; the type, a young animal, having been taken on the Mojave Desert. Since that time no additional material has come under my observation.

A renewed examination of these two specimens has shown me that they belong to two very distinct species. I accordingly name the Tuc-

---

[7] Proc. U. S. Nat. Mus. XVI, 711, 1893.

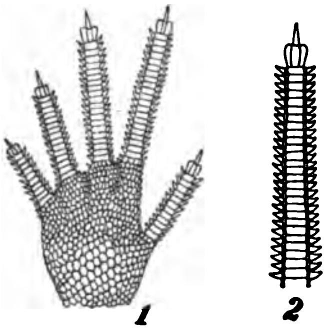
son species *U. scopifera*, and give the following differential diagnoses of the two.

UMA NOTATA Baird. Femoral pores 17–18; labial scales nearly flat; fringes of the inferior eyelid longer than those of the superior; occipital plate larger; digits longer, with shorter fringes of spines; colors pale.

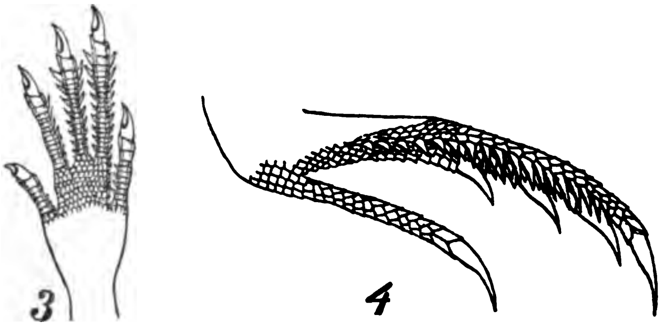
UMA SCOPARIA Cope. Femoral pores 30 in one row, with a second row of 12; labial scales strongly keeled; fringes of eyelids equal; occipital plate smaller; digits shorter, with longer fringes of spines; ground color above black, marked with closely placed discoidal light spots with a black center. (No. 6065 U. S. National Museum).

The fringed digits and sole of this genus constitute an excellent example of homoplassy. Similar fringes are present in the same positions in the Asiatic Agamid genus Phrynocephalus, and in the African Gecconid genus Ptenopus. Both of these, like Uma, are inhabitants of deserts. The spines which compose the fringes penetrate the sand, and give the animal a better hold on it than is secured by the ordinary squamation.

I give figures of the feet of *Ptenopus garrulus* Smith and *Uma scoparia* in illustration of this point.—E. D. COPE



FIGS. 1–2 *Ptenopus garrulus;* 1 anterior foot; 2 anterior digit; from Boulenger.



FIGS. 3–4 *Uma scoparia;* 3 anterior; 4 posterior feet.

On the Genera and Species of Euchirotidæ.—Professor Alfredo Dugés of Guanajuato, Mexico, has sent me an ms. description of a new Amphisbænian from the state of Guerrero, Mexico, which is allied to Bipes (Chirotes Cuv.), but which possesses but three digits, and presents various other differences from the *B. canaliculatus*, including a much shorter tail. In endeavoring to determine its relationships with the known species of Bipes, I find that the individuals from Cape St. Lucas, Lower California, which I have hitherto assumed belong to the *Bipes canaliculatus* Lacép. really represent another species and genus. I now offer diagnostic characters of these forms, preliminary to a fuller notice in my forthcoming Scaled Reptiles of North America.

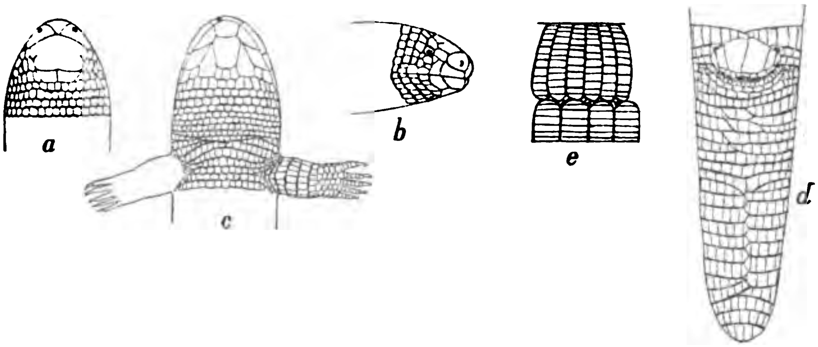


Fig. 5.—*Euchirotes biporus*, Cope.

Digits five, all clawed;	*Euchirotes* Cope.
Digits five, one smaller and clawless;	*Bipes* Lacép.
Digits three, clawed;	*Hemichirotes* Dugés.

Each of these genera includes a single species, which are characterized as follows.

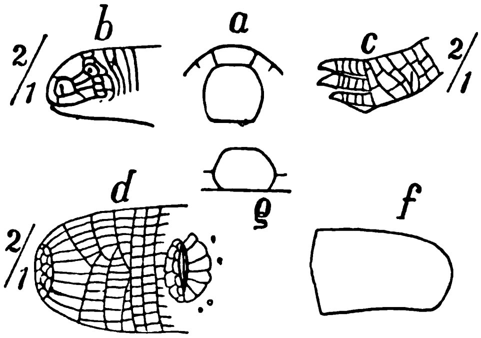


Fig. 6.—*Hemichirotes tridactylus*, Day.

Euchirotes biporus Cope, sp. nov. Tail twice as long as head; anus preceded by a transverse series of six large plates, which extend to the abdominal scuta; a single preanal pore each in a single scale in front of the external preanal plate. Nasal plates nearly in contact in front. Cape

St. Lucas, Lower California. U. S. National Museum; G. Eisen.

Bipes canaliculatus Lacép. Tail twice as long as head; preanal scuta small, preceded by a transverse row of small scales, each of which is perforated by a pore. Nasal plates well separated in front. Mexico.

Hemichirotes tridactylus Dugés. Tail but little longer than head. Anus preceded by six plates of moderate size, and these by only two pore-bearing scales on each side. Nasal plates widely separated by contact of rostral and internasal. Guerrero, Mexico; A Dugés.

Stejneger has shown that the name Chirotes Cuv. must be abandoned in favor of Bipes Lacép. of much earlier date. As the family name Chirotidae has become engrafted on our literature, I propose to retain the name Euchirotidae in place of it for the family, so as to disturb the existing custom as little as possible.

EXPLANATION OF CUTS.

Fig. 5.—*Euchirotes diporus* Cope, twice natural size.

Fig. 6.—*Hemichirotes tridactylus* Dugés, twice natural size.

Letters; *a* head from above; *b* profile; *c* from below, with fore limbs; *d* tail from below; *e* side of body; *f* profile of tail; *g* rostral plate from front.

E. D. COPE.

Zoological News.—PROTOZOA.—Blochmann again replies[8] to the oft asked question, Does the contractile vacuole empty to the exterior? in the affirmative.

F. Schaudinn has studied the *Gromia desjardinii* of Max Schultze and finds[9] that it differs from Gromia in many respects and he proposes for it the generic name of Hyalopus. He has studied its reproduction and finds that transverse fission of both animal and shell occurs, the process requiring about three weeks for completion, the mouths of the new individuals being formed in the cut ends of the shell. Similarly division into three has been noticed. Besides, he has seen in six cases the formation of swarmspores. From five to twelve hours before the formation of the spores the pseudopodia are retracted and the whole protoplasm divides into spherical portions each of which contains a large nucleus. Each of these becomes amœboid and then develops a large flagellum. After some other phases these swarmspores copulate in pairs. The history has not been followed farther.

[8] Biol. Centralblatt XIV, 82, 1894.

[9] Stzber. Ges. Naturf. Freunda Berlin, 1884, p. 13.

MOLLUSCA.—Dr. R. E. C. Stearn's recent paper, "Notes on recent collections of North American land, freshwater and marine shells received from the U. S. Department of Agriculture,"[10] adds considerably to our knowledge of the distribution of several species of Molluscs. No new forms are described.

VERTEBRATA.—H. H. Wilder points out[11] that in the adults of *Desmognathus fusca, D. ochrophæa, Plethodon erythronotus* and *Gyrinophilus porphyriticus*, lungs and trachea are completely absent, respiration taking place by the external skin.

Biétrix claims[12] that in the branchial lamellæ of sharks and teleosts the blood is contained in a system of lacunæ, which, from their lack of membrana propria and endothelium, cannot be regarded as capillaries.

Heinrich Ernst Zeigler studied the yolk nuclei of fishes some years ago. He now returns to the subject and brings[13] new evidence to support his previous thesis that after the close of segmentation the meganuclei of the yolk of sharks and teleosts contribute nothing to the development of the embryos.

Dr. T. H. Bean describes[14] a new genus and species of Blennoid Fish under the name *Plagiogrammus hopkinsii.* The type was collected with other fishes intended for the aquaria at the World's Fair at Monterey, Cal. In confinement it hides in rock crevices and seldom ventures from its place of concealment. It is about 6 inches in length.

Dr. L. Stejneger describes[15] a new species of blind-snake from the Congo region of Africa under the name *Typhlops præocularis.*

Robert Ridgway records[16] as new *Geothlypis poliocephala ralphii* coming from the Lower Rio Grande Valley, the type being found at Brownsville, Texas.

Mr. F. W. True regards Taylor's mouse (*Sitomys taylori*) as presenting such combinations of characters as to warrant its being regarded as the type of a new subgenus to which he gives[17] the name Bæomys. He also describes (l. c. p. 689) a new species of Sitomys (*S. decolorus*) from Honduras.

---

[10] Proc. U. S. Nat. Mus. XVI, 743, 1894.

[11] Anat. Anzeiger IX, 216.

[12] C. R. Soc. Philomath Paris, Jan., 1894.

[13] Ber. Naturf. Gesell. Freiburg, VIII, 192, 1894.

[14] Proc. U. S. Nat. Mus. XVI, p. 699.

[15] Proc. U. S. Nat. Mus. XVI, 709.

[16] Proc. Nat. Mus. XVI, p. 691.

[17] Proc. U. S. Nat. Mus. XVI, 758.

EMBRYOLOGY.[1]

Development of Sponges.[2]—Otto Wass in a comprehensive paper describes the egg development and metamorphosis of several representatives of the Cornacuspongiae, including under this head the Monaxonida, with the exception of the Clavulina and the horny sponges. • For the Monaxonida the embryonic development of *Myxilla* and *Chalinula*, and the metamorphosis of *Axinella* and *Gellius*, are described in detail. For the horny sponges, the development of *Euspongia* and *Hircinia* is outlined. In addition, there are scattered observations on many other Naples cornacuspongiae, and lastly the author presents the results of a renewed study of *Spongilla.*

A fundamental uniformity both as regards embryonic development and metamorphosis, was found to prevail throughout these sponges. The account of the metamorphosis differs but little from the author's previous account of the metamorphosis of the *Esperia* larva, and is very similar to that given by Yves Delage in his last paper (reviewed in the January NATURALIST).

In the marine monaxonida described, the segmentation is unequal. Micromeres in an epibolic fashion surround a mass of macromeres, except at the posterior pole. The micromeres become the ciliated epithelium of the larva, the macromeres constitute the inner mass. The larva thus consists of two layers. In the inner mass some of the cells remain undifferentiated, while the rest alter both in nucleus and cell body, and are collectively known as differentiated cells. Certain of these differentiated cells arrange themselves in an epithelial manner at the surface of the posterior pole. The undifferentiated cells of the inner mass become the amoeboid cells of the adult, from which the reproductive elements are developed. Thus the division into germ and somatic cells is very early brought about.

In the horny sponges the segmentation does not lead to a true morula which dilaminates into an outer layer and an inner mass, as Schulze thought. The segmentation here too is unequal, and the micromeres surround the macromeres as in the monaxonida, the former becoming

---

[1] Edited by E. A. Andrews, Baltimore Md., to whom communications may be addressed.

[2] Die Embryonal Entwicklung und Metamorphose der Cornacuspongien, von Dr. Otto Wass, Zoologische Jahrbücher. Abth. für Anat. und Ontogenie. Bd. VII, 2 Hft., 1893.

the ciliated epithelium of the larva, the latter the inner mass. But in the larva of the horny sponges, as in that of *Spongilla*, the ciliated epithelium is continuous over the whole surface. This is explained by supposing that in these types the ciliated epithelium (micromere layer) completes its growth around the inner mass, which in the other sponges is left bare at the posterior pole.

In the metamorphosis of the two-layered larva of the cornacuspongiae, a complete inversion of the layers take place. The ciliated cells draw in their cilia, and migrate into the interior of the sponge where they form a compact mass, surrounded by the former inner layer. Certain of the differentiated cells of the latter layer unite to form the thin epidermis of the adult. The boundary line between the rest of this layer and the inner mass of once ciliated cells gradually disappears, elements belonging to both layers becoming distributed irregularly throughout the sponge body (process of "durchwachsung"). Groups of the ciliated cells now begin to develop into flagellated chambers. Independent spaces or lacunae appear and become gradually lined with an epithelium formed by the differentiated cells of the larval inner layer. These spaces are the canals. Connection between them and chambers is subsequently established. In two points Wass differs from Delage, in his account of the metamorphosis. Delage believes a special layer of cells, the epidermic cells, can be distinguished in the larva, which during the metamorphosis, take the place of the ciliated cells as a superficial covering. Wass finds no ground for distinguishing the cells which thus form the adult epidermis, from the other differentiated cells of the larval inner mass. Again Delage believes that during the metamorphosis the undifferentiated cells engulf, amorba like, the smaller ciliated cells, subsequently letting them go free to form the flagellated chambers. Wass disbelieves in this remarkable process, though he grants the possibility of amoeboid cells occasionally engulfing ciliated cells, which however are never after liberated, but undergo degenerative changes (i. e. are digested).

On going over the *Spongilla* development the author, aided by his discoveries in marine sponges, finds that a different interpretation in many particulars is to be put upon his earlier observations. The segmentation is not equal, but unequal. A true morula is not established, but instead the smaller blastomeres surround the larger. The ciliated epithelium of the larva is not transformed into the adult epidermis, but the inversion of layers described above takes place in *Spongilla* also. The exhalent canals and flagellated chambers are not formed as diverticula from a single main cavity, nor are the inhalent canals form-

ed as invaginations of the "ectoderm," but both sorts of canals arise as independent lacunae, subsequently acquiring an epithelium and connecting together, and the chambers are formed from groups of the immigrated cells. The development of *Spongilla* is thus brought into accord with that of the marine cornacuspongiae.

In a comparative review of the various types of sponge development, the author points out the fundamental similarity between the development of the cornacuspongiae and that of the calcareous sponges, as exemplified in *Sycandra.* The ciliated cells are homologous in the two kinds of larva, as are the granular cells of the amphiblastula and the inner mass of the other larva. The difference in the character of the metamorphosis arises from the fact that in the amphiblastula there is a large cavity, while in the larva of cornacuspongiae there is none. In this comparison Wass and Delage agree.

The author thinks the development of those sponges (*Ascetta, Oscorella, Plaxira,* etc.), which apparently differ from the plan of development described in this paper, needs to be worked over. A fundamental harmony with the development of cornacuspongidae and *Sycandra* will be revealed.

Touching the relationship between sponges and the other metazoa the author, without dogmatizing, is inclined to believe that they had a common ancestor above the protozoa. This ancestor is represented in the two-layered larva of both. But the community of origin goes no higher than this simple form—the sponges are not coelenterates. In the two-layered ancestor of the sponges, the superficial ciliated cells migrated into the interior, resigning their function of locomotive organs in order to generate internal currents of water, made necessary by the adoption of a fixed habit of life with subsequent increase of bulk. In other metazoa, the ciliated cells continue to form the superficial covering of the body. The immigration of the ciliated cells in the larva of cornacuspongiae, and the invagination of the ciliated cells in the Sycandra amphiblastula, are the ontogenetic expression of this change of position of the ciliated cells in the early ancestors of sponges, and have nothing to do with a process of gastrulation—the two-layered embryo being already formed before the occurrence of this immigration or invagination.

H. V. Wilson.

ENTOMOLOGY.[1]

Shade Tree Insects.—Professor H. Garman[2] publishes an excellent account of the pests of shade and ornamental trees. The article is chiefly concerned with insect pests, which are roughly divided into three groups: (1) Leaf insects, (2) trunk and branch mining insects, and (3) root infesting insects. To the first group belong the largest proportion of species, the walnut-worm, web-worm, elm leaf-bettle and others being included in it. "Such insects attract attention at once from the nature of their injury, the unsightly appearance due to gnawed leaves, webbing and refuse, taking away at once from trees their practical value as shade, and their æsthetic value as ornament.

"While their injuries are not at first so apparent, the work of the boring and mining species is not less injurious, and is the more to be feared because its results are not seen until the mischief under the bark is at an advanced stage. The locust borer and the elm bark-beetle are members of this group, both species being common and injurious in Kentucky. The pine bark-beetles and the fruit bark-beetles now becoming injurious in this State may also be placed here. The greater number of species which attack the trunk are the grubs of beetles. A few are caterpillars (larvæ) of moths. The branches and twigs are injured by a host of small species, some of which girdle them, others mine them, still other species do serious mischief by placing their eggs in them, while some of the true bugs simply puncture and abstract their sap.

"Doubtless the number of insects which feed on the roots of shade trees is large, but the unavoidable difficulties in the way of studying their habits has prevented a very full knowledge of this group."

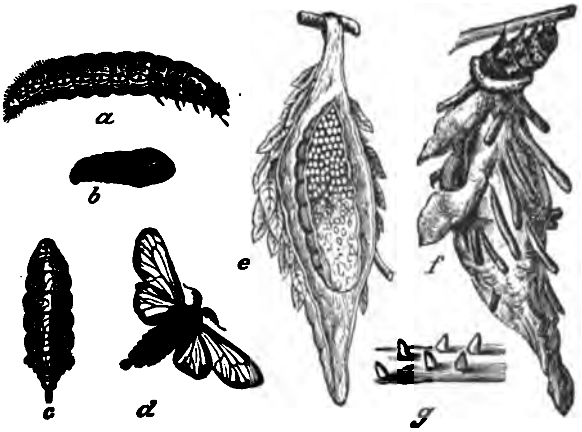
Mr. Garman treats of the life-histories of the species most destructive in Kentucky at some length. The bagworm[3] is one of the first discussed. This worm "lives in and carries about with it a case made of silk, on the outside of which it fastens bits of leaves, probably to render its detection less easy to birds and other enemies. One may see these cases all through the winter adhering to the naked twigs of both deciduous and evergreen trees, the worms having taken the precaution to fasten them there by wrapping the twigs with silk. The case of a grown worm measures 1.75 inch in length and its greatest diameter is some-

---

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Bulletin No. 47, Kentucky Agr. Experiment Station.

what more than .50 inch. If cases are examined during the winter a large number will be found empty, these being old ones which adhere to the twigs longer than one season, or else are those which produced males. In every one which produced a female the preceding summer will be found an oblong brown cylindrical object tapering a little at one extremity, but blunt and with a ragged opening at the opposite end through which the adult insect escaped; for these are the deserted pupal skins of the female. Each appears at first to be full of a powdery material, but on removing some of this the minute soft whitish eggs will be observed packed closely so as to fill the greater part of the skin.



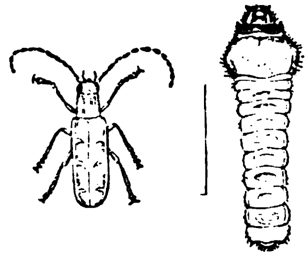
The bag-worm. *a*, larva; *b*, pupa; *c*, adult female; *d*, adult male; *e*, bag containing eggs; *f*, bag containing larva; *g*, young larvæ, with conical cases. (From Riley).

"The adult female of the bag-worm is a very singular creature, looking more like a worm than a moth, incapable of flight, having no rudiments of wings, and with only minute and functionless legs. The very scales of the greater part of her body are abortive, and are rubbed off to constitute the powdery material in which the eggs are packed. Being incapable of flight the most she can do is to wriggle down to the opening at the lower end of her case where she meets the winged mate, and then in the same manner wriggles back to her empty pupa case in which she carefully placed her eggs for safe-keeping during the winter. Finally with an astonishing solicitude for the walfare of her prospective young, she deserts the case, drops to the ground, and dies shortly afterward. Is it possible that this pulpy mass, exhausted, with nothing more to live for, with death certain and at hand, understands

that a dead and putrid body left in the case would work harm to her precious eggs? Anyway she leaves the case."

Mr. Garman photographed a member of the cases from different trees, as shown on the accompanying plate. Those marked *a* are from red cedar; *b*, from maple; *c*, from arbor vitæ; *d*, from spruce; and *e* from white pine.

An extended account of the elm borer (*Saperda tridentata*) is also given. This insect had done serious injury to some of the largest and finest elms in the city of Frankfort. The nature of the damage is well-shown in the plate reproduced herewith. Washing the bark with a mixture of whitewash and Paris green is suggested as a preventive measure.



Elm-borer: larva and adult.

Larval Habits of Brachinus.—Mr. H. F. Wickham records (in the Canadian Entomologist) finding in northern Iowa the larvæ of a species of Brachinus parasitic on the pupæ of *Dineutes assimilis.* "The larva lies in the cell of its host and extracts the juices from an opening made in one of the wing-pads; the maggot-like body is adorned, but not supported by six very soft and short legs, which can be of little service except perhaps as 'feelers' in its dark abode. The little animals were carefully watched and examined several times a day, until finally the larger one, having withdrawn nearly all the juices from the pupa and become swollen to an unwieldy size, changed after a day or two of resting into a pupa.

"How the Brachinus gets into the cell of it host, whether brought in as a young larva clinging to that of the Dineutes, or deposited as an egg by the mother is a mystery to me. When small it is more active than when larger grown, and with advanced age becomes gradually more helpless. In any case the complete adaptation to a parasitic habit is apparent in the whole structure—the soft, juicy body, unprotected by chitinous scutes, the weak legs quite useless for ambulatory purposes, and the lack of strong locomotive bristles. The appearance is almost that of some Hymenopteron, not at all resembling the strong raptoreal larvæ of the Adephaga in general."

North American Trypetidæ.—Mr. W. A. Snow makes an important addition to our knowledge of a little-studied family of Diptera

in his descriptions of North American Trypetidæ, with notes.[3] Good descriptions of a large number of new species are published, together with valuable notes on the distribution of those already known. Two new genera—Polymorphomyia and Xenochæta—are characterized. Two plates illustrate the wing markings of many species.

North American Dolichopodidæ.—Professor J. M. Aldrich in his New Genera and Species of Dolichopodidæ[4] describes five new species, and characterizes two new genera—Dactylomyia and Metapelastoneurus. He also gives a table of the species of Sympycnus.

Entomological Notes.—At a recent meeting of the Entomological Society of London Mr. S. H. Scudder "exhibited the type-specimen of a fossil butterfly—*Prodryas persephone*—found in beds of Tertiary Age at Florissant, Colorado. He said the species belonged to Nymphalidæ, and the specimen was remarkable as being in more perfect condition than any fossil butterfly from the European Tertiaries. He also said that he had found a bed near the White River on the borders of Utah in which insects were even more abundant than in the Florissant beds."[5]

K. T. Nogakushi of the Imperial University, Tokio, publishes[6] a preliminary notice of his investigations of the Spermatogenesis of *Bombyx mori.* The author distinguishes four zones in the follicles: the formative, growing, ripening, and that of metamorphosis.

At a recent London sale a specimen of *Chrysophanus dispar* sold for six pounds, ten shillings; and a pair of *Noctua subrosea* for six pounds six shillings.

In his report as Dominion Entomologist for 1893, Mr. James Fletcher discusses a large number of injurious insects affecting various Canadian Crops.

---

[3] Kansas University Quarterly, II, 159-174; Jan., 1894.

[4] L. c. 151--157.

[5] Ent. Mon. Mag., V, 22.

[6] Zool. Anzeiger, XVII, 20.

ARCHEOLOGY AND ETHNOLOGY.[1]

The non existence of paleolithic culture.—There appeared in the January number of THE AMERICAN NATURALIST a criticism by Mr. H. C. Mercer of my recent paper "On the Evolution of the Art of Working in Stone," which induces me to ask for space for an answer.

My paper in the *Anthropologist* for July 1893 was necessarily restricted, and, although only a preliminary one, had I thought, made some points clear in the discussion of paleolithic man which appeared to me not to have had particular attention drawn to them.

Geology, anatomy and prehistoric archeology are all of the greatest value in the study of the early history and development of the human race, but a study of the technology of archeology, I contended is equally important in determining the mechanical status of the race at any period of its existence.

(1) I contend that "Teshoa or chip-knife" making at one blow, or making a "turtle back" at twenty blows (if turtle back is all we want), may be as easy as, but is not *easier*, than hammering and grinding. The present status of archaeological information fully justifies the expression of a doubt that either a "teshoa" or "turtle back" is a completed instrument.

(2) That Pottery is recorded as found in the lower European cave strata, (and the authorities who make the assertion are fully sustained) "warrants a review of the French classification."

(3) "Why" Says Mr. Mercer "men who bored, polished and carved bone, sketched realistic designs, and chipped blades equal in make to Mexican sacrificial knives did not polish stone, seems incomprehensible. But the European museums clearly assert that no polished stone tool has been found in the caves. If true, the fact is conclusive against Mr. McGuire."

One of the chief points which my paper raised was, that the ability to do these things (bone polishing etc.) was sufficient proof of itself that those who did them could and did polish stone tools, and further, such polishing required less acquaintance with the fracture of stones, simpler tools, and less technical ability, than was necessary in chipping and flaking stone, and in scraping and etching bone, etc.

---

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

I do not deny that the hammer was used for many different purposes, but assert that its shape proves it to be intended for stone working, and not for corn bruising.

(4) I think that this is answered under No. 1. I deny that the "Coup-de-poing" materially differs from the "turtle-back." Both are apparently unfinished implements. The "turtle-back" presents its refractory part in a ridge down the center of a proposed implement. The refractory part of a "coup-de-poing" is on its periphery, and is generally due to a knot in the stone. No two stones have the same fracture; the same stone will show a variety of fracture in a given vein.

(5) Polished implements have been found in the caves also in the clays, and in the bogs; in localities entitling them to be classed as of the quaternary period with as much claim of right as any chipped stone.

(6) Admits that pottery is not to be expected in the drift.

The admission that European cave classification requires revision carries with it the admission that it is erroneous.

I fully realize that it is considered by a very large class of archeologists as heterodox, to deny the existence of a paleolithic period. The classification of paleolithic periods into those of St. Acheul, Chelles, Mousterian, Magdalenian, etc., is demonstrably inaccurate, and needs revision and simplification. The advocates of paleolithic man assert that his mechanical development was so low, that the only stone work which he was capable of performing, was to knock flakes from stones with a few blows at most and subsequently to use them as cutting implements, by holding them in the naked hand, yet they admit that while he was in this low stage of mechanical development he was possessed of artistic attainments, and that he could and did etch or engrave the representations of animals on stone, bone and ivory and that he could at this time make the gravers and other tools which such work required.

They further assert that he went through a distinct period extending over centuries, in the gradual development of the art of chipping stone, until finally he made chipped implements of exquisite shape which cannot now be duplicated. At the time when he had scarcely learned to chip rough flakes on one side, it is shown that Paleolithic man made needles of bone with eyes carefully drilled through them, that he made bone pins and ground them, that he fashioned spear heads of bones with barbs or opposite sides, that he possessed organized government and recognized in the Batons-de-Commandment the insignia of rank; these articles being found with an arctic fauna necessitate the

admission that he was sufficiently clothed to resist the cold, if so, he must have possessed fire and shelter, all of which would require intelligence. It cannot be denied that with such weapons as he possessed, he successfully attacked a fauna more powerful, and presumably more ferocious, than any now known to man. Man cracked the bones of these animals, and had, it is asserted, a particular shape of spoon with which to extract the marrow, yet it is seriously argued that man in a cultural state such as indicated, had not learned the art of rubbing one stone against another in order to give it a cutting edge, but did rub one piece of ivory on a stone to smooth it for the reception of an engraving on it of a mastodon. Ivory is little at all softer than certain of the stones from which the so-called Neolith was often made. My experiments and my reason and every hour's work I have done, convince me that with our *present* data no one has the right to divide the stone age into a chipped and polished age, much less to divide the chipped age as has been done. The argument has no reliable evidence to support it.

I am sure I will be judged leniently when I claim that an intelligent study of archeology depends for its value upon some different classification than now sustains it.

Whether such classification can be made upon some such basis as was laid down twenty years ago by Prof. Otis T. Mason, or (if the classification is to be confined to stone implements alone,) whether that of DeMortillet or of Holmes will develop in the most valuable hypothesis, I cannot say. I am inclined, however, to believe in that of the latter, if there be added to it an arrangement to study the handles of implements, the development of attachment of the same, and the rapidity with which they may be worked, for the working part of most implements show little change in form from the earliest known.

J. D. McGuire.[2]

Professor W. Boyd Dawkins on Paleolithic Man in Europe.—How much Prehistoric Archeology leans upon Paleontology has recently been shown by Prof. W. Boyd Dawkins (Journal of the Anth. Inst. of Grt. Britain and Ireland, Feb., 1894, p. 242) in a comparison, by fossils and human remains, of the two great divisions of prehistoric time in Europe. He thus compares them:

(a) The earlier period, called *Paleolithic*, now cold, now hot, of the Hippopotamus, Mammoth, Rhinoceros, Musk Ox, Reindeer, Cave Hyena, Cave Lion and Cave Bear, with man a nomad hunter lacking all domestic animals, who chipped but could not polish stone, and

---

[2] Of the Smithsonian Institution, Washington, D. C.

PLATE XI.

Bag-worm cases on various trees.

PLATE XII.

Elm with bark removed, showing injury by borers.

(b) The later time, called *Neolithic*, of still existing species and climate, with man an agriculturist possessor of the dog, goat and hog, who chipped and could also polish stone and make pottery.

Prof. Dawkins passes by the questioner who might here ask whether the first described man was really paleolithic, and accepts without hesitation the two custom honored titles, Paleolithic and Neolithic, as labels for his paleontological periods.

But if M. Dupont found the celebrated earthen bowl along with boar, horse, urus, chamois, goat, wildcat, hare, beaver, and reindeer bones, in the Trou du Frontal (on the Lesse near Furfooz) and at the Engis Cave (near Liege), a potsherd at the same spot where Dr. Schmerling had found his "Philosopher's" skull along with Mammoth, horse, hyena and bear bones in 1833; and if a bit of pottery was really found in the layer of cave bear, cave lion, rhinoceros, hyena, bison and mammoth bones, at Surignac Cave (Haute Garrone, France), after a farmer named Bonnemaison had mixed up the layers and lost the human bones; if pottery was found in the alleged paleolithic caves of Nabrigas (Prof. Joly), Vergisson (M. Fery), and Trou Rosette; and if MM. de Puydt and Lohest found three burned potsherds about nine feet down in the La Biche aux Roches Cave (near Spy, Belgium), under elephant and rhinoceros bones; then the word paleolithic, devised to signify an early non-pottery-making, non-stone-polishing stage of human culture, would lose much of its meaning.

Sir John Lubbock, when called upon to defend his word and its notion that man chipped a long time before he polished stone, cannot look for support to the flaking Australians, who, in the Kamalarai Country, used a ledge of sandstone rock as an axe polisher (Frazer's Aborigines of New South Wales, Sydney, p. 76) and often ground tomahawks and grooved axes (Brough Smith's Aborigines of Victoria, 1, p. 366, figs. 177, 178, 183, 189); though he may, it seems, look to the recently (about 1850) extinct Tasmanians, who never appear to have polished or got beyond chipping stone tools that resemble what M. de Mortillet calls Mousterian flakes.

It is the paradoxical mixing of the fauna of the above named earlier or paleolithic time in Europe that chiefly interests Prof. Dawkins and would call for such explanations as alternate periods of heat and cold, as hippopotamus and reindeer migrations, and as the preservation of animal carcasses in ice as food for later carnivora; to account for certain caves where, to the confusion of the naturalist, the bones of the boreal Mammoth and tropical Hippotamus are mixed together,

and heat loving spotted hyenas have gnawed the fresh bones of the arctic reindeer.

Puzzles like these may be finally explained by the study of such superposed plistocene layers as those of Abbeville, which, according to M. G. d'Ault du Mesnil, indicate that the fauna grew newer and a warm climate became colder as we approach the latest bed, as follows:

SOMME GRAVELS, ABBEVILLE.

(a) UPPER TERRACE (oldest).

Elephas antiquus, E. primigenius, Rhinoceros merkii, R. tichorinus, Hippopotamus major, Ursus speleus, Cervus megacerus, Hyena spelæa, Machærodus cultridens, Trogontherium cuvieri, Equus caballus, Bos primigenius.

(b) MIDDLE TERRACE.

Elephas antiquus (declining), *E. primigenius, R. tichorninus* (increasing), *Equus caballus, Cervus elaphus, Bison priscus, Rhinocerus merkii* (declining), *Hippopotamus major, Ursus speleæus, Cervus megaceros, Hyæna spelæa, Machærodus cultridens, Trogontherium cuvieri, Equus caballus, Bos primigenius.*

(c) LOWER TERRACE (latest).

Elephas primigenius, Equus caballus (dominant), *Rhinocerus tichorinus* (numerous), Reindeer, *Cervus elephus, Cervus tarandus, Bos primigenius*, Ursus (not determined) and *Cyrena fluminalis.*

Turning to the associated human remains, in Prof. Dawkins' first period, cave runs into cave and rock shelter into Drift so unclassifiably that we had better, he thinks, stop subdividing the epoch into Drift, Mousterian, Solutrian and Magdalenian, and call it all by one name, Paleolithic.

But while objecting to breaks in his Paleolithic, the sharp break between it and the Neolithic is his main point. As no grading together of fossil remains bridges over this gulf, so, he thinks, (spite of pottery rumors from paleolithic caves) that the human relics of period a, and period b, show a corresponding hiatus.

The few Drift-like chipped blades, produced at the Institute meeting from the (period b) Cissbury neolithic quarry were easily explainable as inchoate celts and wastrels, and the fact of their looking like (period a) Drift specimens was enough to call a halt to the surface gatherer and the labeller by type and, we might add, clear the

museums of Europe of many hastily classified "paleoliths." Perhaps this was the same kind of Drift likeness that I had observed in April, 1893, among the ruder incipient forms at the (period b) Neolithic quarry of Spiennes in Belgium (The Archæologist, July, 1893. AM. NATURALIST, Nov., 1893). But at Spiennes as at all other quarries that I have studied and mutually compared, it is evident that the *results* of each blade maker's workshop, by which alone we can explain the wastrels, must be first understood. Whatever the similarity between Neolithic Cissbury and the paleolithic Drift (and the British Museum specimens show none) neolithic Spiennes does not come much nearer the paleolithic drift workshop of Abbeville, through the similarity of rudest wasters in either case, than it does to Flint Ridge, Ohio.

If Prof. Dawkins recognizes no human chipped implement grading out of his Paleolithic period, so he will not with Prof. Prestwich allow the work of a more primitive alleged predecessor of the Drift man to grade into it, holding that the variously nicked flints "Plateau implements" found by Mr. B. Harrison on the high Kentish downs are of Drift and not pre-Drift age. But he does not clearly say whether he thinks that these curious specimens are blade refuse, finished implements or, as Mr. W. G. Smith of Dunstable (who writes me that he has found many in the Drift-blade bearing gravels at Caddington) regards them, the work of nature.

Prof. Dawkins showed also at the meeting a good example of a modern "paleolith," a North American Indian soapstone quarry pick, and with it a stone tool very modern yet simpler in form than any paleolith, one of Dr. Leidy's much ignored and often misunderstood "teshoas," seen used by Utes, together with a set of Trenton specimens obtained by Prof. Dawkins and which he said should, with their fellows collected by Dr. Abbott and Professors Putnam, Haynes, Morse, Carr, and Shaler, be placed, until further proof be furnished, in a suspense account.—H. C. MERCER.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

National Academy of Sciences.—This body met in Washington, D. C., April 17th. The following papers were read. I. Histological Characteristics of Certain Alpine Plants, G. L. Goodale. II. Corrosions by Roots, G. L. Goodale. III. An Investigation of the Aberration and Atmospheric Refraction of Light, with a Modified Form of the Loewy Prism Apparatus, George C. Comstock (Presented by S. Newcomb). IV. Biographical Memoir of John Le Conte, Joseph Le Conte. V. The Coral Reefs of the Bermudas, A. Agassiz. VI. The So-called Serpulæ Reefs of the Bermudas, A. Agassiz. VII. The Bathymetrical Extension of the Pelagic Fauna, A. Agassiz. VIII. New Method of Determining the Relative Affinities of Certain Acids, M. Carey Lea. IX. On the Change of Young's Modulus of Elasticity with Variation of Temperature, as Determined by the Transverse Vibration of Bars of Various Temperatures, A. M. Mayer. X. On the Production of Beats and Beat-tones by the Covibration of two sounds, so high in pitch, that when separately sounded they are inaudible, A. M. Mayer. XI. On the Motions of Resonators and Other Bodies Caused by Sound Vibrations, with Experimental Illustrations; also a Reclamation, A. M. Mayer. XII. On Late Researches on the Variation of Latitude, S. C. Chandler. XIII. On the Infra-red Spectrum, S. P. Langley. XIV. The Bacteria of River Water, J. S. Billings. XV. The Influence of Light Upon the Bacillus of Typhoid, and the Colon Bacillus, J. S. Billings. XVI. Recent Gravity Instruments and Results, T. C. Mendenhall. XVII. The Geographical Distribution of Fishes, Theo. Gill. XVIII. Note on a Possible Increase in the Ultimate Defining Power of the Microscope, C. S. Hastings. XIX. The Internal Energy of the Wind, S. P. Langley.

No election of members was had. The Academy discussed a plan of division into classes without reaching a definite conclusion.

Natural Science Association of Staten Island, Februry 10, 1894.—Mr. William T. Davis exhibited specimens of the seventeen year locust found in various years since 1877, and read the following paper.

THE SEVENTEEN YEAR LOCUST ON STATEN ISLAND.

Our island will resound with the rattling song of the seventeen year Harvest fly or "Locust," during the latter part of next May and in

the month of June, and it may not be uninteresting in view of the fact, to give a short account of the species in connection with this locality. It must be borne in mind that while *Cicada septendecim* Linn. appears at intervals of seventeen years, its advent is not in the same year in all of the middle states, or in all the counties of this State, but that there are separate broods or colonies, that emerge in great numbers in districts of varying extent, the limits of which are not sharp or well defined. Thus it happens that while there is a certain brood that appears periodically on our island, and attracts at such times general attention, there are also other years when the *Cicada* occurs in small numbers. At such times it will often be found that a brood is emerging not many miles away, and that the island lies within the outer margin of the territory.

This matter of distribution and much more regarding the seventeen year *Cicada*, and the more southern thirteen year form, has been recorded by Professor Riley in Bulletin No. 8 of the U. S. Department of Agriculture, Division of Entomology. Professor J. A. Lintner, New York State Entomologist, also gives, in his second annual report, the distribution of the *Cicada* in this State, noting five broods as occurring within its limits.

In 1826 this *Cicada* appeared in great numbers on the island, as I have been informed by my grandmother; in 1843 they came again, as recorded by Thoreau, and still again in 1860 and in 1877. In the latter year I saw many tree trunks and fences brown with their cast pupa skins, and the whir of their flight and monotonous song, could be heard in every direction. Dr. Fitch, in 1855, wrote of the seventeen year *Cicada* and records this brood as inhabiting the valley of the Hudson River. Since his time, the various broods in different parts of the country, have been numbered for convenience, and the one inhabiting the valley of the Hudson and Staten Island, is known as No. XII.

During the visitation of 1877, I noticed that many of the *Cicadas* were affected by the singular fungus *Massospora cicadina* Peck. While the insects were alive and walking about the fences and the tree trunks, if the abdomens of the infected individuals were suddenly jarred, they gave forth a cloud of innumerable spores. It has been stated that only injured specimens are attacked by this fungus, and then only toward the latter part of the season.

Since 1877, the seventeen year *Cicada* has not appeared on the Island in great numbers, and probably but few have been noticed except by those who have looked for them. The facts connected with

appearance, as far as known to me, may be arranged chronologically as follows:

1881, BROOD XVIII.

While collecting insects with Mr. Leng in the neighborhood of Watchogue, we found a red-eyed *Cicada* pupa under a stone, and on the 5th of June, eight specimens were collected, many of them being wet, having but recently emerged. By the 12th of June, they had become quite numerous, and I counted about one tree near Silver Lake, fifty-two pupa skins. The brood to which these insects belonged does not appear in great numbers in the east, but is mainly located in Wisconsin and the neighboring States. Staten Island, Essex Co., New Jersey, and Germantown, Penna., were apparently, the only eastern localities from which the insect was reported in 1881.

1885, BROOD XXII.

I made special search this year for the Periodical *Cicada*, as one of the most widely extended broods known, was to make its appearance. On the western end of Long Island in the neighborhood of Brooklyn, they came in some numbers, and also sparingly in New Jersey, the main body in the east, however, occuring in Pennsylvania and thence southwestward.

On the Island the insects must have been quite scarce. Mr. James Raymond and I, were walking along a wood-path in the Clove Valley on the 4th of July, when we found a wing that probably some bird had pulled off a red-eyed *Cicada*, as they so often do. To those who are acquainted with the character of the wings of this insect, their colors etc., this will constitute ample authority for its presence. In the autumn, an old pupa skin was collected, and the following April, another was found at South Amboy, New Jersey.

1888.

On the 16th of June while in the valley of Logan's Spring Brook I heard a *z-ing* in the distance like that produced by the seventeen year *Cicada*. As it stopped shortly and was not repeated the search was abandoned. Eight days later, when by the same brook the song was again heard, and this time followed to apparently the same tree from whence it came on the previous occasion. After some search the insect was detected on the under side of the limb, and captured. One of its fore wings was deformed so that it was unable to fly, and of course must have been born in the immediate vicinity. This was the only individual seen during this year.

1889.

Brood No. VIII was expected to appear in southern Massachusetts, on Long Island and in parts of Pennsylvania and West Virginia in the summer of 1889. It returned, according to a note in Vol. 1, No. 4, of the Proceedings of the Entomological Society of Washington, in considerable numbers in parts of North Carolina and West Virginia, and in less numbers in the District of Columbia, Maryland and New Jersey.

The only evidence that the seventeen year *Cicada* occurred on Staten Island in 1889, consists of a pupa skin found on a grass stem during the summer by Mr. Jos. C. Thompson, and kindly given to me.

1890.

During this year the *Cicada* was not expected to occur in any part of the country. In June and July, I found in a garden in New Brighton, three pupa skins, and my sister discovered one of the perfect insects on the trunk of a pear tree, but it was unfortunately destroyed by the family cat. Mr. Leng also found a red-eyed *Cicada* on an apple tree near the Moravian Cemetery, while he was "beating" for Longicorns.

On the 8th of September 1890, I found, in a hill of potatoes, a live red-eyed *Cicada* pupa, which I endeavored to rear, but without success.

1892.

On June 5th, I heard a seventeen year *Cicada* at West New Brighton, and the next day Mr. Leng's children caught me a specimen, and a few days later a second example. On the 11th of June there were many of the *Cicadas* singing in the high trees about Logan's Spring Brook, and on the 12th, I heard one near Rossville.

1893.

On June 11th, the *Cicadas* were fairly numerous in the woods along Willow Brook, and later in the month I heard them along Logan's Spring Brook. Mr. Leng's children also gave me two specimens from his garden at West New Brighton.

It is well-known that a few seventeen year *Cicadas* often make their appearance in the year previous to their general visitation, so that those collected in 1893, and even in 1892, may have been precursors of the general swarm which is to come early next summer, that is, seventeen years from the visitation of May and June, 1877.

March 10.—Mr. L. P. Gratacap exhibited pieces of a drift bowlder containing fossils, and read the following paper:

ADDITIONS TO THE DRIFT FOSSILS OF STATEN ISLAND.

These specimens represent the remainder of one of the bowlders found by Mr. Arthur Hollick, at Prince's Bay, last autumn, mentioned in our Proceedings for Nov. 11, 1893.

The rock is a lower Helderberg limestone, somewhat crystalline and shaly, and affords numerous fossils, conspicuous among which is *Stropheodonta varistriata* var. *arata* Hall, a fossil brachiopod characterized by a very convex ventral valve and by prominent ribs, which are scored by numerous delicate striae, easily discernible under a low magnifying power. This fossil assumes some importance, in its numerical representation, in the lower Helderberg beds of Becraft's Mountain, east of the Hudson River, in Columbia Co., and the most easterly exposure of the Helderberg series of strata in New York State. It seems safe, from this fact, and a close lithological similarity in the material of the bowlders with the Becraft stone, to conclude that this "wanderer" commenced its travels southward from that distant point. Associated with it are a few lamellibranchs, which are seen less commonly in our drift material, and were actually less important elements in the Helderberg Sea. These are *Pterinea communis* Hall, *Pterinopecten bellula* Hall, and *Aviculopecten umbonata* Hall, all new to the Island. Upon one of these *Pterina communis* there is the half effaced trace of a pygidium or tail of *Lichas bigsbyi* Hall, a trilobite and a not common species, usually found in separated heads and tails. Its identification as *Lichas* is unquestionable, but in the complete absence of any considerable evidence, from the poor nature of the specimen, it is not certainly separated from *L. pustulosus.* If *bigsbyi,* as is probable, it also indicates Becraft's Mountain as its origin. Amongst the brachiopodous remains in these fragments we find *Rensselæria mutabilis* Hall, *Meristella bella* Hall, and *Orthis eminens* Hall, all new in our Island finds. Besides these molluscs there are seen, in these fossil remains, plain and broad sheets, or fronds, of the bryozoan *Lichenalia,* showing both the poriferous and non-poriferous surfaces. The species I am unable at once to determine. Besides this there is a fenestrated polyzoan, *Fenestella œsyle* Hall, as far as I can fix on its specific nature. The heteropod *Platyceras gebhardii* Hall is another new species, although this reference may be doubtful, as in this genus of shells the species run insensibly into each other and the present multiplication of these specific names seems provisional.

Amongst these specimens are two Oriskany sandstone species, ***Rensselæria ovalis*** and ***Platyceras nodosus***, which were detached by Mr. Hollick from the same bowlder which yielded the Helderberg fossils. This places the rock in the upper Lower Helderberg strata, probably the Upper Pentamerus beds, and exhibits the faunal emergence of the life of the Oriskany Ocean. This find illustrates still further, if illustration was necessary, the paleontological importance of our drift material and provides additional incentives to further investigation.

Mr. Thomas Craig exhibited a living myxomycete under the microscope and read the following paper:

SOME OBSERVATIONS ON THE BEHAVIOUR OF A MYXOMYCETE.

In Bennett and Murray's book on Cryptogamic Botany mention is made of this form of life as the sixth sub-division. It is placed between the fungi and the protophyta; but at the end of their description they say: "We are justified in placing these organisms outside the limits of the vegetable kingdom."

Dallinger, in his edition of Carpenter on the Microscope, places them in the animal kingdom, in close affinity with the rhizopods. Saville Kent, after prolonged investigation placed them in the animal kingdom. All these writers follow DeBary, who in 1859 first published the result of his researches, and his conclusions that they were more nearly allied to animals than plants. DeBary's conclusions were fully confirmed by Saville Kent, who traces the development as follows: Suppose the existence of a sporangium; this bursts and liberates the spores which in presence of water give birth to a globular protoplasmic body, which becomes after a time a flagellate infusorian, capable of ingesting solid food. It then loses its flagellæ and becomes an *Amœba*. Two of these conjugate and attract a number of other like bodies, or become joined to them in some way not understood. These form what is known as a plasmodium, a portion of which I exhibit under the microscope. This plasmodium is capable of apparently voluntary motion. It goes forward and retreats by a flowing motion, carrying embedded in its substance various species of algae which it has captured as food. There is a remarkable resemblance in the mode of movement between the myxomycetes and the proteomyxa. The same flowing motion of the protoplasm and the joining of the filaments to form larger ones.

The reason for the foregoing prelude is that during the month of February I have been watching one of the myxomycetes—which has developed in some water taken from the Old Town pond—into what

may be called its animal stage. In the glass jar in which it is growing it resembles a miniature tree of many branches, flattened against the glass. Before it made its appearance the glass jar was so covered with growth of algae that one could not see through it. As soon as the myxomycete made its appearance and had travelled a short distance, the glass on that part over which it passed was comparatively clear. Now that the myxomycete has gone several times round the jar, the glass is quite transparent. I took some measurements of its rate of progress.

On Feb. 26, from 2.15 p. m. to 8.45 p. m. it had travelled 1¼ inches.

Feb. 27, at 9 p. m. the distance covered was 6½ inches.

Feb. 28, a 9 p. m. 10¼ inches.

March 1, at 9 p. m. 15¼ inches.

So you will observe the rate of progress is not uniform, but the average rate of progress was 5-26ths inch per hour. A curious circumstance is that while the plant life disappears in all parts of the glass over which the myxomycete moves, it does not seem to interfere with the animal life on the glass. There are a large number of the brown *Hydra* and numerous small worms, which do not appear to be affected in any way, although they are surrounded by the plasmodium of the myxomycete.

I have not been able to definitely name the species, owing to the absence of the sporangium, but from figures I have seen it resembles *Didymium serpula.* Of course in the foregoing there is nothing very new, but having been fortunate enough to get so fine an example, so favorably located for examination, I thought it might interest some of the members to see under the microscope, an object about which so many diverse views have been held by botanists and zoologists. Apparently the only reason for the botanical claim to it is the fact that in its reproductive stage it forms sporangia like some of the fungi, while on the other hand, from its first appearance in the water or in damp places it acts precisely like an animal in its mode of progress and its way of taking in and digesting solid foods.

MISCELLANEOUS MATERIAL EXHIBITED.

Mr. L. W. Freeman presented a mastodon's tooth, obtained from Staten Island Sound by Mr. Seeley Van Pelt, while tonging for oysters. Its value was not understood by the finder, who allowed it to be thrown away with the refuse oyster shells, into Old Place Creek, from whence it was recovered by Mr. Freeman.

Boston Society of Natural History, March 7.—The following papers were read: Mr. F. P. Gulliver, The Newtonville sand plain; Mr. J. B. Woodworth, Some typical eskers of southern New England.

April 4th.—The following paper was read. Prof. F. W. Putnam: The department of ethnology at the World's Columbian Exposition.

SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington, March 10.—The following communications were read: Mr. C. H. Townsend, The Ornithology of Cocos Island in its Relation to that of the Galapagos Archipelago; Mr. B. T. Galloway, A Hexenbesen of *Rubus*: Mr. M. B. Waite, The Hexenbesens of Washington and Vicinity. Illustrated with lantern slides.

March 24.—The following communications were read: Dr. Theobald Smith, On the Significance of Variation among Species of Pathagenic Bacteria; Mr. Vernon Bailey, On some Bones from a Cave in Arizona; Mr. C. D. Walcott, On some Appendages of the Trilobite; On the Occurrence of Fossil Medusæ in the Middle Cambrian Terrane.

April 7.—The following subject was discussed. What is a Living Cell?

FREDERIC A. LUCAS, *Secretary.*

SCIENTIFIC NEWS.

Agriochœrus and Artionyx.—Mr. Hatcher has lately collected and sent to me from the White River bad lands of South Dakota a number of specimens of the genus *Agriochœrus* Leidy. This material demonstrates the fact that the genus *Artionyx* of Osborn and Wortman is a synonym of *Agriochœrus* and very probably, that the specimens which I described under the name of ? *Mesonyx dakotensis* from the same horizon, should be referred to the same or to some closely allied animal. A description of this extraordinary type will very soon be published. W. B. SCOTT.

The Haeckel Celebration.—On the 16th of February, Ernst Haeckel completed the sixtieth year of his life. On the 17th, the little town of Jena, in whose University Haeckel is Professor of Zoology, was thronged by a great crowd of his friends, pupils and admirers, among whom may be specially mentioned the Hertwigs (Oscar and Richard), Waldeyer, Arnold Lang and Hermann Credner, besides many well known professors of Jena itself. The chief ceremony of the day was the uncovering of the marble bust of the great scientific worker and writer, from the chisel of the eminent sulptor, Professor Kopf of Rome. At noon the lecture-theatre of the Zoological Institute, in which the greater part of Haeckel's life work has been carried on, was crammed from floor to ceiling, and Professor R. Hertwig, of Munich, the pupil, friend and colleague of Haeckel, was called upon to unveil the bust. In an admirably-worded speech be alluded to the main facts of Haeckel's life, and especially to his labors in the cause of science and scientific freedom. The unveiling of the striking bust was the signal of a great outburst of applause, and when this had subsided, a deputation from some societies, the Medicinishe-naturwissenschaftliche Gesellschaft of Jena and the Geographische Gesellschaft of Thüringen, offered to Professor Haeckel their honorary membership. They were followed by a deputation from the students, who expressed in enthusiastic terms their admiration and respect for the Professor of Zoology. Professor Max Fürbringer of Jena followed with details concerning the subscription to the bust, informing us that there had been nearly 700 subscribers, who sent their tokens of appreciation from all parts of the world; he especially alluded to the gratifying fact that many subscriptions had come from France. As a consequence of this, the total

amount exceeded the cost of the bust by at least £300, and this sum he had pleasure in placing in the hands of Professor Haeckel, for him to devote to such purpose as he might think best in the interests of science.

After the ceremony, and after Professor Haeckel had, not without emotion, acknowledged the honors showered upon him, the elect among the visitors adjourned to a banquet in the Hotel Zum Bären, where covers were laid for about 120 of both sexes. The day concluded with the characteristic German institution, a "Commers," in which almost all the students in Jena seemed to be taking part. Cheers for the Professor, songs and speeches in his honor, mingled with the clinking of glasses, enlivened the old university till a late hour at night.—*Natural Science*, March.

Mr. Henry O. Forbes, well known for his interesting account of his travels through the Eastern Archipelago, has been appointed Curator of the Liverpool Museum.

Dr. J. Boehm, the botanist, of Vienna, is dead at the age of 62.

Richard Spruce, the botanist, died at Coneysthorpe, England, Dec. 29, 1893, at the age of 76. He traveled extensively in his younger years and accumulated one of the most valuable herbaria in England; he also published numerous botanical papers, but he will longest be known from his successful efforts in introducing the Cinchona plants into India.

Dr. Friedrich Zschokke has been made ordinary professor of zoology in the University of Basel, in the place of Prof. Dr. L. Rütimeyer retired.

Dr. J. Vosseler, formerly of Tübingen is privat-docent of Zoology in the technical high school of Stuttgart.

Dr. W. Migula, formerly docent, has been made Professor of Botany and Bacteriology in the technical high school at Karlsruhe.

Dr. Saposchnikoff has become Professor of Botany at the University of Tomsk, Siberia.

Mr. R. T. Günther is to be science tutor in the Magdalen College, Oxford.

The library of the late Prof. A. Milnes Marshall has been given to Owens College, Manchester, by his friends and executors.

The Sixth Geological Congress will meet in Zürich from August 20 to September 2, 1894.

Dr. Justus Karl Hasskarl, the botanist, who introduced the cultivation of Cinchona into Java, died at Cher, Prussia, Jan. 5, 1894.

Edmond Frémy, Director of the Museum of Natural History at Paris, is dead.

Alexander Theodor von Middendorf, the Arctic explorer, died Jan. 28, 1894. He was born in St. Petersburg in 1815.

Dr. K. Zelinka of Graz has been appointed extraordinary professor of zoology in the University of Vienna.

The list of literature in the current volume of the "Zoologischer Anzeiger" has been greatly improved, not only by being brought out more promptly than heretofore but by the addition of abstracts of a few lines stating the substance of the article. It may be that editors and publishers were spurred up to this by the announcement of the "Zoologisches Centralblatt," the first number of which bears date Feby. 1, 1894. This new publication is designed to furnish abstracts of the principal articles at the earliest possible moment. It is edited by Dr. A. Schuberg of Karlsruhe, with the assistance of Professors Bütschli of Heidelberg and Hatschek of Prag. The first number, containing 40 pages, is not remarkably strong.

The San Francisco Microscopical Society extends a cordial invitation to those interested in microscopy to visit its rooms, 432 Montgomery St., San Francisco, Cal., and to attend its meetings the first and third Wednesday of each month. The officers for 1894–95 are Prof. W. E. Ritter, president; W. E. Loy, vice-president; F. E. Crofts, recording secretary; G. O. Mitchell, corresponding secretary; C. C. Riedy, treasurer.

The following is the list of officers of the Zoological Society of Philadelphia: President, Charles Platt; Vice-president, J. Vaughn Merrick; Corresponding Secretary, Prof. H. C. Chapman; Treasurer, William Hacker; Directors, W. H. Merrick, I. J. Wistar, C. W. Trotter, F. S. Fassitt, G. C. Morris, F. W. Lewis, M. D., C. M. Lea,

C. C. Febinger, D. S. Sellers, S. G. Dixon, M. D., J. B. Henry, J. B. Leonard.

Hon. Walter Rothschild proposes to publish a periodical in connection with his museum at Tring, under the title of "Novitates Zoologicæ." It will contain papers on mammals, birds, etc., and also discussions on questions of zoological or paleontological interest. Descriptions of new species will be confined almost entirely to those of which the types belong to the Tring Museum, and the other articles will, for the most part, be founded on work carried on at that museum or on specimens sent by Mr. Rothschild's collectors.

From the March number of *Forest and Stream* we learn that the buffalo in Yellowstone Park are again being harassed by hunters. A year ago this winter several buffalo were killed; last spring and the spring before, a number of calves were captured; this winter ten buffalo have been slaughtered at a single killing. At this rate it will not be long before the last shall have been shot down. It is for the people to say whether or not they desire this.

Dr. Robert Lamborn has presented a valuable library of archeology to the University of Pennsylvania.

The Zoological Garden of Philadelphia purchased the orang-outang which was on exhibition in the Javanese Village at Chicago. It is a very intelligent and cheerful animal. Subsequently it acquired a pair of Cheetahs, and the rare *Felis egra* and *F. jaguarondi* from Mexico.

Extracts from examination papers: "The meganucleus breaks up, the micronucleus breaks down." "I don't quite understand the difference between Bacterier and posterior."

THE

AMERICAN NATURALIST

VOL. XXVIII. June, 1894. 330

THE MEANING OF TREE-LIFE.

BY HENRY L. CLARKE.[1]

Few there are, even among thoughtful botanists, who seem to clearly realize how broad a lesson on the life-history of plants is written in the trees that make the great forest regions of the world. Whether we stand among the palms of the tropics, or the pines of the north, or the congeners of the poplar and oak, we feel instinctively that there is an impressive depth of meaning in the very aspect of a tree. And it is no deception of the fancy. Tree-life represents the culmination in the work of one of the two great factors, reproductive energy and vegetative energy, that together shape the course of plant-development. The history of plants records a constant two-fold struggle; on the one hand the effort of plant-life as a whole to perpetuate itself by improving its methods of reproduction; on the other, the stand for self-preservation made by each distinct individual or species or group,—a stand that can be taken only through sheer force of vegetative luxuriance. But these two phases of the struggle for existence have by no means been independent of each other; they have acted together in varying ratio in the making of every type, though their respective influences have culminated in widely separated forms. As the highest outcome of evolutionary progress in the character of floral organs we point to

---

[1] University of Chicago.

the orchids, among Monocotyls, and the kinsmen of the goldenrods and asters, among Dicotyls; as the monarchs of vegetative energy stand the tree-ferns and towering palms of the tropics, the Red-Woods of California, the Eucalyptus of Australia, and our forests of mighty oak. Thus the classification systems of modern botany that review in the clearest scientific light the evolutionary relationships of species, genera, orders, and classes, present to us only one side of the problem of plant-life; the dynamics of vegetation is the other. We may know that the Coniferae are among the most primitive of flowering plants, and the Orchidaceæ and Compositæ among the highest; but why do we find our orchids and composites growing as stunted herbs in the very shadow of conifers that are giant trees? Which is master of the situation? Systematic botany has not fulfilled its mission until it has grasped both sides of the two-fold relation that the contrasting types bear to one another.

Far back in geologic time the dawn of tree-life came almost with the beginnings of vegetation. What the earliest of those beginnings were we can scarcely even conjecture, but going back as far as fossil botany will carry us with certainty, we may conceive something of the conditions under which the primitive plant-world was fostered. Consider the probable conditions of the Cambrian and Silurian Ages. However, scant the records that we hold, they are yet sufficient to give us some suggestions of inestimable importance. Past question the earliest forms of plant-life were denizens of the water, developed in the seas and lakes of Pre-Cambrian times. From their aquatic habitats they must have first gradually emerged, as the cooling of the primordial continents permitted, and the strengthening of their own anatomical characters favored, into the swamps and marshes, and then step by step mounted the higher regions of the dry land. The oldest fossil types we with certainty know of were far from the beginning of the scale; they could only have been products of ages of development that must forever remain to us almost a total blank. The world of Silurian times was probably a torrid zone from pole to pole, a condition traceable in large part to the insular

character of its continents. The surcharging of the atmosphere with water-vapor meant excessive precipitation, and the shallow-water conditions obtaining around the continental islands, together with the probable lowness of these isolated landmasses favored the existence of extensive swamps and marshy flats, in which the water may have been either fresh or brackish. Here in these primordial swamps the vegetation destined to cover the earth made its determined struggle for existence. On the higher land there was too much heat; in the seas there was too much water; in the swamps was the requisite combination of water, heat, and heavy carbon-laden air. Under such conditions the first types that took possession must have spread and multiplied with incredible rapidity. What followed? Inevitably the primitive low-growing plants crowded closer and closer together and became a rank tangle of growth; where there had been at first plenty of room for every individual to spread, there were now many struggling for the mastery of each square foot of swamp. All had a foothold in the earth but only the few that stood the highest could drink in the feeble rays of the cloud-bedimmed Silurian sunshine. Then the real battle for the light began in earnest, the stronger against the weaker, the older established types against the newer ones whose foot-hold was less certain; higher and higher the rank swamp-growth rose, all its members struggling together for the light and open air. And so in the wierd gigantic club-mosses of those far-off times we see the prophetic beginnings of the tree-life of to-day; and to trace the development of the majestic forests of the present from those dank swampy jungles of the past is the problem before us. It would seem at first glance that in the primæval jungle "might made right," if ever it made it anywhere. But no! the "survival of the fittest" worked in two directions. Vegetative luxuriance was a tremendous factor in determining the survival of types, vastly more so then than now; but wherever an improvement in the character of reproductive organs increased the certainty with which any plant could perpetuate its race, that gain could often far outweigh the superior vegetative luxuriance of all competitors. This second factor in the "survival of the fittest"

has been steadily waxing in importance from primæval times, while the other has begun to wane. In the midst of the Silurian jungle, where the energy of plant-life was strained to the utmost limit of activity, new forms originated. What was their fate? They could not overpower the strongly established older forms crowding all about them, so either they must perish or push outward toward the open margin, where there was room to fight. Thus the swamp-margin became the tension-line between the uninhabitable higher land and the old strong hold of the jungle, and on this tension-line stood the vanguard of the world's future vegetation. On its outer edge the tension-flora faced a new and untried habitat, and then, as now, a highly specialized habitat meant highly specialized inhabitants. The untried ground could not be conquered by sheer force of vegetative luxuriance, for by their very nature the new conditions were physically opposed to the established order of things in plant-life. The all-powerful factor in accomplishing the conquest was increased capacity for variation and the adaptive evolution of old structural types into higher stages of organization. Clearly, this tendency predominated and pervaded the whole tension-line flora, but its maximum was toward the outer edge. So here were ranked the low-growing herbaceous forerunners of coming ages,—forms that were humble in their growth, because of the physical obstacles opposing them; and highly specialized, because their structure did not possess the obstinate stability of the patriarchal tree-life behind them. For the same reasons the character of the undergrowth in the jungle must have always been ages in advance of the arboreal monarchs towering overhead. But on the inner side of the tension-line, vegetative luxuriance was not only possible and potent but also obviously a necessity, for there could be no abrupt demarkation between the marginal and central regions. Here, then, where the jungle-flora merged into the tension-flora, was the stronghold of the rising generations, the newer higher types, of tree-life. Here, in early Silurian times, must have stood the ancestral types of the great tree-ferns and calamites and conifers that were to be supreme in the Carboniferous and early Mesozoic.

The history of plant-life through the later Silurian and the Devonian Age records the first strong establishment of a truly dry-land flora, a substantial foreshadowing of the Mesozoic. The changes in physical conditions of course furthered this result no less truly than did the adaptive evolution of organic forms. In the dry-land forests of the Devonian rose the vegetation whose future developments should hold dominion when the primordial swamps had disappeared from the earth. But these terrestrial forests evidently had the effect of removing an immense part of the pressure upon the old swamp-jungles by becoming the main refuge and stronghold of the new types crowded out at the old tension-line. This, together with the physical changes recorded in the rock-systems of the times, gave full vent to the gathering vegetative energy that reached such a stupendous culmination in the mammoth swamp-flora of the Coal Age. Here was a turning point in plant-history. With the dawn of the Mesozoic came the clear prophecy of modern conditions. The dry-land forests of the Reptilian Age were the full realization of the conditions foreshadowed in the Devonian. Out of the swamp-forests of the Carboniferous came some of the highest Lycopods, great Tree-Ferns, and giant Equisetums. Down from the Devonian came the Conifers of the yew-family; and as reminders of the old genus Cordaites the new order Cycadaceæ appeared. Undoubtedly it is impossible to believe that the swamp-flora of the coal seams represents anything like the whole flora of the Carboniferous Age. There must of necessity have also existed then a great transitional dry-land flora between the terrestrial forests of the preceeding Devonian and the succeeding Jura-Trias. Much of the strata called Devonian or Mesozoic probably represents this transition and was synchronous in its formation with the accumulation of the coal. Part of the transition is clearly observable in the noncarboniferous formations included between the coal-seams. While the preparations, begun in the Devonian, for the great Mesozoic forests were slowly and surely progressing, the old vegetation of the swamp-jungle swept up to its culmination, and marked by its decline the close of the Paleozoic Era. The early Mesozoic

became the age of Gymnosperms. Vegetation had come upon a new battle-field, the terrestrial forest-ground, and only the most highly organized types of preceeding ages were fitted to enter the struggle. Many of the Tree-Ferns and Equisetums were still powerful, but the supreme dominion passed over to the Conifers and their allies, the Cycads. The great forests of Conifers had their undergrowth and their tension-lines, and here the development of new types was progressing with probably even greater activity than in the tension-floras of earlier times. The greater complexity of the conditions confronting a terrestrial flora over those confronting a swamp flora would necessarily mean more elaborate specialization. While the ancient coniferous tree-forms were mounting to the fulness of their power the first types of the higher flowering-plants were beginning to appear; and with the opening of the later Mesozoic, the Cretaceous, two new groups of tree-life came upon the stage as worthy competitors of the old established Gymnosperms. One was the order Palmaceæ, representing the Monocotyledonous Angiosperms; the other was the amentaceous hardwood tree-families, representing the Dicotyledons. The opening chapter in the history of these two groups is a matter of peculiar interest.

It is probable that the two groups were almost, if not quite, synchronous in their rise; though there is some reason to believe that the Palmaceæ, or at least their forerunners, the Pandanaceæ, are slightly the older. As has been indicated the central strength of the Mesozoic forests was undoubtedly held by the coniferous trees; and probably by far the greatest strength was vested in the near allies of the Cypresses, Pines, and Firs,—representing the tribes Cuprèssineæ, Taxodieae, Abietineæ, and possibly also Araucarieæ,—while the older suborder Taxineæ, the broad-leaved Conifers of the Yew family, were rather crowded out toward the tension-line margins along with the Cycads and Tree-Ferns. Among these last the first low-growing Tree-Palms probably rose, as the products of a long course of elaborate specialization. It is more than possible that the Pandanaceæ represent at least in part a transitional stage between some of the higher Gymnosperms and the

Palmaceæ; and it is well worthy of note that the aerial roots of the Screw-Pines, the Pandanaceæ, are a living memorial to the position they originally held on the shore-margin of a forest tension-line. The habit of growth of the Palmaceæ most strikingly suggests that their first competitors were Tree-Ferns and Cycads, even as they are in many regions to-day. It seems as if the first Palms had met the Mesozoic Tree-Ferns and Cycads on their own ground,—the forest margin,—with their own weapons—the tall aspiring trunk topped with a crown of leaves. And by their general higher character of organization the Palms ultimately asserted their preeminent superiority. The wide constrast between the floral characters of the Palmaceæ and those of the Gymnosperms presents a difficult problem. There is a strong likelihood, however, that the spadiceous inflorescence of the Screw-Pines and Palms is a highly specialized development from the cones of some aberrant Cycad or Conifer. At least all the probablities indicate that the spadiceous Monocotyls approach much nearer the Gymnosperms than do any of the non-spadiceous ones. All this has evidently a most significant bearing on the question before us, of the Palms' place in Nature. We have seen that the vegetative character of the Palms was widely different from that of the dominant Conifers; and now we note that their floral organs were also widely different, and in fact far more decidedly unlike the cones of the Cypresses and Pines than are the "catkins" of the hardwood dicotyl trees.

There are a half-dozen or more tree-orders among the Dicotyls that should really stand apart as forming a small subclass quite decidedly distinct from the rest of the Dicotyls. As the principal orders of this group may be named the Juglandaceæ, Myricaceæ, Salicaceæ, Betulaceæ, Fagaceæ, Ulmaceæ, Platanaceæ, and a couple of others. These have been called the Amentaceæ, or the Diclinæ, and might be regarded as a subclass. Except in the approach of Ulmaceæ to the Urticaceæ, the Diclinæ stand clearly apart as a distinctive highly specialized alliance of trees and shrubs. Their relation to the Mesozoic Gymnosperms is an interesting question. In general habit of growth and in the character of their wood they evidently make a close approach to the Conferæ.

The amentaceous inflorescence predominating in the group bears a decided likeness to the cones of the Pines and Cypresses. Obviously then, the Diclinæ were the trees best fitted to battle with the central stronghold of the Mesozoic coniferous forest, and probably they were first fully developed on the inner portion of the tension-line, face to face with the strongest of the Conifers. Behind them, toward the outer edge stood the Tree-Ferns, Cycads, and Palms; but which, we may ask, were the Conifers that stood closest round about, among and before them? Probably the sub-order Taxineæ, the fraternity of broad-leaved Taxites and Gingkos. The power of this most ancient group of Conifers had, as we have seen, waned, and they must have been driven toward the outskirts of the forest by the stronger Cupressineæ and Abietineæ. Here they must have met the early Diclinæ. Where did the Diclinæ develop the broad flattened leaf-blades that so strikingly distintinguish their foliage from that of our living Coniferæ? Where, if not in a competitive struggle with the broad-leaved Taxineæ of the Mesozoic forest-margin? The ancient Taxineæ had reproduced in their foliage something of the character of the fern-fronds; the newer Pinaceæ had rather imitated and exaggerated the scale-leaves of the great Carboniferous Lycopods. And finally, the broad leaves of the Taxineæ were perpetuated, under greatly improved and elaborated forms, in the Diclinæ. Through the Cretaceous the Coniferæ rose to the zenith of their power; the Tree-Ferns and Cycads weakened; the Palmaceæ and Diclinæ, more particularly the latter, fast gathered strength toward the dominion they claimed in the succeeding Tertiary. Meantime, in the undergrowth and on the open margins of the forests, and on the open country that did not support a growth of trees, the evolution of the higher types of Monocotyls and Dicotyls was rapidly progressing. Many of the stronger forms became shrubs, and here and there a peculiarly favored type rose from lowly herbaceous to arborescent habit, and thus founded a new tree-group. Such, for instance, were the Magnolias and Tulip-Trees and Maples and many others. In all this we read an increasing complexity in the conditions presented to onward struggling plant-life, and here a vitally important point rises for our consideration.

(*To be continued.*)

THE SCOPE OF MODERN PHYSIOLOGY.

BY FREDERIC S. LEE.

(*Continued from page 388.*)

Three achievements of the present period have shown investigators how broad their science really is. First, the establishing of protoplasm as the physical basis of life, and of its substantial identity in plants and animals by Dujardin, Von Mohl, and Max Schultze, showed that the really fundamental problems of life and action had heretofore not been grasped; that the essential laws of protoplasmic activity apply to the whole organic world; and hence that any physiology which confines itself rigidly to either plants or animals to the exclusion of the other is a one-sided science. Second, the cell-theory of Schleiden and Schwann demonstrated that sooner or later many functions must be traced back to the cell, and that a cellular physiology is the key to a large proportion of the problems arising in the biological world. Third, the work of Darwin, based, as it was, upon physiological principles, showed that the action of the environment upon the individual and upon the species, as well as the action of the organism upon the environment, was an almost unworked field of the richest promise; that all physiology, in order to be complete, must be comparative; that there is an ontogenetic and a phylogenetic evolution of function; and that the physiological laws of heredity were yet to be discovered.

Let us examine these ideas briefly. The necessity of understanding the physiology of undifferentiated protoplasm is obvious, for there we find function in its simplest and most generic form. The phenomena of projection and retraction of pseudopodia in the Amoeba are doubtless the key to the complex processes of contraction and relaxation of striped muscular tissue. It is not at all improbable that the action of light upon the retina is a specialized derivative of the heliotropic phenomena of the simplest plants and animals. Four years

ago, the well-known Oxford physiologist, Burdon Sanderson, wrote concerning the nature of the physiological inquiry, "The work of investigating the special functions, which, during the last two decades, has yielded such splendid results, is still proceeding, and every year new ground is being broken and new and fruitful lines of experimental inquiry are being opened up; but the further the physiologist advances in this work of analysis and differentiation, the more frequently does he find his attention arrested by deeper questions relating to the essential endowments of living matter, of which even the most highly differentiated functions of the animal or the plant organism are the outcome." Again, "No one who is awake to tendencies of thought and work in physiology, can fail to have observed that the best minds are directed with more concentration than ever before to those questions which relate to the elementary endowments of living matter, and that if they are still held in the background, it is rather because of the extreme difficulty of approaching them than from any want of appreciation of their importance. * * * * If we really understood them, they would furnish a key, not only to the phenomena of nutrition and growth, but even to those of reproduction and development. * * * * It is in the direction of elementary physiology, which means nothing more than the study of the endowments of living material, that the advance of the next twenty years will be made."

Regarding the need of a cellular physiology, it is only neccessary to review our knowledge of any one of the complicated organs to perceive that aside from the principles, often chiefly mechanical, involved in the work of the organ as a whole, the essence of its activity lies in the activity of its component cells. The work of the muscle, *e. g.*, is the sum of the activities of its constituent physiologically similar fibres. A single gland cell illustrates the principles of secretion as well as, or even better than, a thousand grouped together into a compact gland. The complexity of brain operations is due to the complexity of brain structure, but the active agents are the comparatively simple nerve-cells. Huxley sets forth as the first three of the five chief ends of modern physiology: "Firstly, the ascertain-

ment of the facts and conditions of cell-life in general. Secondly, in composite organisms, the analysis of the functions of organs into those of the cells of which they are composed. Thirdly, the explication of the processes by which this local cell-life is directly, or indirectly, controlled and brought into relation with the life of the rest of the cells which compose the organism." Now that the structure of protoplasm is fast becoming disentangled, a rational cell-physiology will be possible. In urging the need of investigating cell-function, I do not mean to imply that the cell is necessarily the ultimate unit, and that the organism is to be regarded as substantially a colony of physiologically independent cells. Much of the recent cytological work indicates that ere long the cell may be deposed from its hierarchical position.[1] Cellular interactions are to form an increasingly prominent place in the researches of cell-physiologists. But, whether or not we grant with many that the cell is of secondary significance, we must allow that, in many respects at least, it may be regarded as a physiological unit; and from this standpoint it demands investigation.

In these days of comparative science, it seems superfluous to urge the necessity of a comparative physiology. No one, who thinks seriously of the matter, will doubt that along with the morphological distinctions between different species, genera, orders, or classes, and even in cases where gross morphological distinctions are not apparent, there must be physiological differences. Beyond the obvious facts of simple observation, these are almost wholly uninvestigated. De Varigny, in his suggestive little book on Experimental Evolution, has collected a number of the known facts. In a garden in the south of France, were growing, side by side, a number of plants of the same species. There appeared to be no morphological differences between them, but some were indigenous to the soil in which they were growing, while others had been imported from the Canary Islands. When they were attacked by frost, all the Canary Island forms perished, while the French forms were untouched. There was evidently some obscure physiological difference between them. The two common European species

[1] Cf. Whitman, *Journal of Morphology*, VIII, No 3, August, 1893.

of frogs, *Rana temporaria* and *Rana esculenta*, behave very differently toward certain drugs, as Schmiedeberg, Monnier, Vulpian, Harnack and Meyer, and others have shown. In *R. temporaria*, caffeine causes a decrease in excitability; in *R. esculenta* an increase; in *R. temporaria* pilocarpine causes paralysis; in *R. esculenta* tetanus. The venom of one snake is harmless for its own species, but poisonous for others. The spinal cord of the fish is differently endowed from that of the frog, though the differences have never been properly investigated. The muscle of the Insect is far removed functionally from that of the Crustacean, though how far remains to be discovered. I do not overlook the fact that already much excellent work upon the physiology of the Invertebrates and lower Vertebrates has been done, but too often such work has not been *comparative.* Fitness for the object of the research is the usual determinant of choice—and hence the frog has taught us most of our physiology of muscle. Sooner or later this must all be changed, the functional differences must be made known, and the exact position of each plant, each Invertebrate, and each Vertebrate, in the physiological series, together with the exact position of his organs and tissues and cells must be understood. For we must recognize the fact that function in any one species has *come to be*—an evolution of function is as much a reality as an evolution of form. The adult body and its organs, tissues and cells are the functional derivatives of the germ-cells—in the growth of the individual there has been a physiological ontogeny. So in the growth of the species there has been a progressive or retrogressive development of function; and one of the most attractive fields for our future work will be the tracing out of the phylogeny of function, now a practically unknown subject.[2] The difficulty of such an undertaking is great, for the rich palaeontological series is beyond the reach of the experimentalist. Yet this should be no bar to the systematic investigation of existing forms. Such a phylogeny will vary with each functional part (organ, tissue or cell); *e.g.*, if, in one genus, certain brain functions and certain secretory functions are always found, the presence of the same brain

---

[2] Cf. Dohrn, *Das Princip des Functionswechsel.*

functions in another genus does not necessarily indicate the presence of the same secretory functions. Nor will the line of functional descent of a part necessarily coincide with the line of morphological descent of the organism. A natural system of classification is based and, justly so, on morphological considerations. In thus tracing out the genetic relationships of function, lie the attractiveness and the utility of the comparative method in physiology. And I venture to assert that, if all investigators would bear in mind the fact of an evolution of function, surprising advances would result in our knowledge of the working of adult organs.

What is it that makes an individual physiologically what he is? There are two agents—heredity and the environment. As to heredity, the active discussion now going on around Weismann as a centre, serves to show what a vast amount we do not know, on both the morphological and the physiological sides as regards the general phenomena of heredity and the nature and behaviour of the hereditary substance. No one recognizes this more fully than Weismann himself. He confesses that his own theory is far from complete; that its importance consists primarily in its suggestiveness; that the real solution of the problem lies in the future, and that facts are greatly needed. In this connection I may refer to the value of the work of Nussbaum, Gruber, Balbiani, Hofer, Korschelt, Verworn and others on the physiological relations of the nucleus and cytoplasm.

The mutual relations of the environment and the individual are almost as unknown as when Darwin first demonstrated their importance. In a few special lines they have been investigated. In his earthworm studies Darwin himself set an eminent example. The fact of the modification of the virulence of pathogenic bacteria by their treatment during growth is well known. Interesting results have been obtained regarding the action of salt-water on fresh-water animals, and *vice versa;* the action of salts on starch production in plants; the effect of depriving animals of apparently important salts, *e. g.*, fowls of carbonate of lime, and crabs of calcium chloride. Maupas's well-known studies on the influence of temperature on

the determination of sex may be mentioned here, as well as those of Yung, Mrs. Treat, and others on the influence of foods. If an altered environment is capable of altering function—and we know this to be a fact—and if the altered function reacts upon structure—which is equally undoubted—then we find in these premises sufficient justification for searching after the facts concerning the nature and extent of environmental influence. The value of such researches lies not so much in the isolated results themselves, as in the fact that such results, when sufficiently numerous, will lead us directly not only to a better understanding of the internal physiology of organisms, but, what is of more general interest, to an understanding of the causes of variation, and thus to a better comprehension of the relations of species to one another. Too much cannot be said upon this phase of our subject. Whether the direct action of the environment is to be considered as a factor in organic evolution or not, the causes of variation must be investigated *experimentally*, and the physiological side of the work must not be neglected. Semper says, "Although the morphological section of animal biology[3] teaches with much probability that this species or that organ has undergone this or that course of modification in the animal series, and that in the process of modification it has passed through a whole series of various forms, still it is only physiological research that can elucidate the necessity for their existence by revealing their causative conditions."

One word regarding the relations of physiology and morphology. In the broad way in which I have outlined the former science, it may be charged that I have trespassed upon the morphological preserve. I do not deny the charge. It seems to me altogether unnecessary, undesirable and moreover impossible to draw a sharp line of distinction between the two sciences. With a common origin, mutual independence was, in time, necessary to the growth of each, yet this is in entire harmony with the fact that they have a common meeting-ground. In these days, as always, the morphologist must be something of a physiologist; the physiologist something of a

[3] He might justly have omitted the word "animal."

morphologist. The current researches and discussions on evolution, heredity, and other fundamental questions make this constantly more evident. Like zoology and botany, each has its special field of labor, its special methods, and its special problems; but the fields are constantly overlapping, the one learns methods from the other, and the ultimate problems of both are the same.

Let us now draw together the main lines of our thesis. I prefer to conceive of physiology as the science of the dynamics of living matter. Its tasks for the future seem to comprise the following classes of investigations.

First, the functions of adult organs, tissues and cells in plants, Invertebrates and Vertebrates. The greatest interest at present appears to center about the phenomena of heredity, the central nervous system, and general cell physiology. Second, the ontogeny of functions, or embryological physiology. Third, the phylogeny of functions. Fourth, the physiology of organisms, comprising the mutual relations of organisms to each other and to their environment.

It would be superfluous here to discriminate between the opportunities for research offered in these four classes of problems. Each covers a wide field of rich promise. Each is largely worked—in reality, as we have shown, research in the past has been confined almost wholly to the first group. Each will lead the investigator to fundamental problems.

In considering these tasks it will be perceived that I have viewed the organism in two aspects, in its internal and its external relations. The problems of the first three groups may be regarded as belonging to *internal physiology*, those of the fourth to *external physiology*. Nearly twenty-five years ago, Haeckel made a similar division into *Conservations-* and *Relations-Physiologie*.[4] Such a classification is convenient and valuable. But it must be remembered that it is artificial, and must not be taken as indicating a fundamental distinction between two sciences. The two are departments of the one science, physiology, and pass the one into the other. For a fact that becomes the more striking, the longer one studies the

---

[4] *Jenaische Zeitschrift*, V, 1870.

dynamics of living matter, is the utter impossibility of drawing a sharp line between the internal and the external. The functional organism is constantly acted upon by the environment, and is incapable of existence apart from it. But the functional organism is but the *ensemble* of the functional parts, and the parts are linked functionally together, constantly acting and reacting upon each other and modifying each other's work. It follows that the innermost portions cannot free themselves from environmental influence, and the attempt at an essential separation of internal from external physiology is in vain. Nor is such an attempt justified any the more by methods of investigation. For he who studies the action of light upon the retina, is thereby fitted to investigate the heliotropic phenomena of the organism; and he who is familiar with methods by which the effect of salts or temperature on the organs is tested, is most capable of testing the influence of the composition and the temperature of the surrounding water upon aquatic animals and plants. I speak of this the more especially because of the fact that, since the completion of the greater portion of this paper, the able address of Professor Burdon Sanderson, as President of the British Association for the Advancement of Science, has appeared.[5] In an interesting manner Professor Sanderson reviews the aspects of physiology since the time of Müller. He says, "The distinction * * * * between the internal and external relations of plants and animals has, of course, always existed, but has only lately come into such prominence that it divides biologists more or less completely into two camps—on the one hand, those who make it their aim to investigate the actions of the organism and its parts by the accepted methods of physics and chemistry, carrying this investigation as far as the conditions under which each process manifests itself will permit; on the other, those who interest themselves rather in considering the place which each organism occupies, and the part which it plays in the economy of nature. It is apparent that the two lines of inquiry, although they equally relate to what the organism *does*, rather than to what it *is*, and therefore both have

---

[5] *Nature*, September 14, 1893.

equal right to be included in the one great science of life, or biology, yet lead in directions which are scarcely even parallel." Giving then a somewhat misleading interpretation of Haeckel's ideas above referred to, Professor Sanderson proceeds to divide Biology into three parts, Morphology, Physiology, which deals with the "internal relations of the organism," and Oecology (a term borrowed from Haeckel) "which concerns itself with the external relations of plants and animals to each other, and to the past and present conditions of their existence." In another place, Professor Sanderson says, "No seriously-minded person, however, doubts that organized nature, as it now presents itself to us, has become what it is by a process of gradual perfecting or advancement, brought about by the elimination of those organisms, which failed to obey the fundamental principle of adaptation, which Treviranus indicated. Each step, therefore, in this evolution, is a reaction to external influences, the motive of which is essentially the same as that by which, from moment to moment, the organism governs itself."

I realize how presumptous it appears in me to differ from or attempt to criticise the views of one who occupies so deserved a place among the foremost physiologists of to-day. Yet I cannot repress the thought that the author of the Nottingham address viewed his subject more in the waning light of a day that is ending than in the brightening beams of a coming dawn. If each "step * * * * in this evolution is a reaction to external influences," why should not the student of the "steps" study also the origin and causation of those steps? I think he would justly be open to the charge of narrowness if he did not do it. And, moreover, as I have indicated above, I believe not only that he of all is best fitted, but that a rational view of his science forces him to do it. The progress of a scientific physiology has been greatly retarded by its followers confining themselves too exclusively to "the internal relations of the organism." Not the least of the retarding consequences is the fact that thereby the science loses much of its attractiveness. Just as anatomy, illumined and vivified by the theory of evolution, and broadened by the incorporation of embryol-

ogy and paleontology, became the science of morphology, so I believe that physiology is destined to undergo, and is undergoing, a similar vivifying and broadening process, and is to become the science of vital phenomena, wherever and however they may be exhibited.

UNUSUAL FLIGHTS OF THE GROUSE LOCUST (TETTIGIDEA LATERALIS SAY,) IN NORTH EASTERN ILLINOIS.

BY JOSEPH L. HANCOCK.

At certain times, seemingly without premonitory indications, some insects suddenly change their habitat; although closely allied forms inhabiting the same locality under similar general influences, show no disposition to do so. That there are predisposing conditions which are the ruling causes of these specific migrations is plainly evinced by careful study. Before confining our remarks to a single species *Tettigidea lateralis* Say, " The Grouse Locust " as an illustration in point, a sketchy recapitulation of the phenomena of migration in the family Acrididæ, of which the above is a member, may be given to some advantage. The various forms of grasshoppers, constituting this large family, are not as a rule migratory; as a matter of fact, somewhere near a dozen only are given to making sudden sweeping changes, by flight over a large territory foreign to their hatching grounds. In two species, whose anatomical differences are but very slight, one may be truly migratory while the other is not, as seen for example, in *Melanoplus spretus* and *Melanoplus femurrubrum*. The confusion arising from an indefinite interpretation of migration in its truest sense, as distinguished from the shorter "local flights" as appled to insects, is often perplexing. Let us attempt to set at rest, as far as possible, such misconception of terms.

Individuals of a species which effect a more or less regular periodical change in their habitat, are truly migratory. Migrations may be primary, consisting of local flights; such as movements by insects hatched in temporary regions to which they confine themselves to passing to and fro, from point to point, or secondary, as the repeated periodical changes of residence covering foreign fields, which virtually establishes a nomadic habit. We have hinted that there are predetermining

conditions effecting these movements, principal among them being a break in the interrelation of food supply, or improper conditions for the carrying on of propagation. The unusual appearance of insects in a given locality, classed under the category of primary or "local flights," are met with occasionally by observers. One of considerable moment is set forth in the following narration: On the nineteenth of September, 1893, the Grouse Locust, with a few other members of Acrididæ, striking out for more favorable conditions, landed at night in swarms in Chicago. The writer noticed them everywhere in the city. The small size of this locust (♀, ♂—12–16 mm.) in length, with peculiar inconspicuous colors, caused them to be overlooked by the people passing the next day who, without being conscious of the fact, crushed thousands under their feet, leaving tiny stains upon the sidewalks. Again, two days following their first appearance, on the twenty-first inst., multitudes of Grouse Locusts dropped during the night. As individuals, they were comparatively large and vigorous. Many were taken to indicate the range of flights; specimens being recorded at scattered points. A region covering, not only the City of Chicago, but the northeastern portion of Illinois and that part of Indiana including the lower bend of Lake Michigan adjacent, as shown in the accompanying map Fig. 4, was represented. Observations in the city showed that the electric arc lights, to which they were attracted, killed off large numbers, while the stretch of waters in the lake destroyed others.

Through the streets, in the heart of the city, the writer collected in a short time, twenty-seven specimens, comprising thirteen males and fourteen females, showing a remarkably even distribution of sexes. A significant point indicating the direction from which they came was gathered from the fact that most, if not all the specimens, when examined, on the streets running east and west, were on the north side of the street, showing that they were blown against the tall buildings and then dropped to the ground. Information received from Mr. H. C. Frankenfield, local forecast official, who kindly favored the writer with a report, giving the direction of the wind

at the time of the flights, is appended below. It is interesting to note that the preconceived idea of their course was confirmed. His report indicated that the wind during the twenty four hours which brought in the Grouse Locusts on the night of the nineteenth inst. blew from:

Southeast	2 Hours.
South	3 Hours.
Southwest	19 Hours.
Total	24 Hours.

The general direction pointing from the southwest. In the second flight the wind blew from:

East	1 Hour.
Southeast	18 Hours.
South	4 Hours.
Southwest	1 Hour.
Total	24 Hours.

Showing a mainly southeastern wind.

Nothwithstanding a residence of many years in this locality, no other instance of unusual migration of this particular species has been observed, except during the preceding fall, 1893, which was characterized also by flights in very small numbers, marking the first instance of their occurrence here. Of the natural breeding grounds of this species, but little is known in this section of the State of Illinois, beyond the fact of their existence along the Des Plains River at Riverside. In general terms, it may be inferred that the natural habitat is along the border of streams (J. H. Comstock[1]), about ponds (W. S. Blatchley[2]), in the vicinity of mud flats and low marshy places. The species is sub-aquatic in habit and widely distributed. (Lawrence Bruner[3]).

The predetermining causes of the singular flights noted above, may have been induced one way or another by the extreme dryness of the fall seasons of 1892–3. Indeed it is safe to assume that these conditions played a direct part, as will be

[1] Introduction to Entomology.

[2] From specimens so labeled in my collection.

[3] MS. letter.

seen from the following observations. On September 16, 1893, it was observed that the large stream at Riverside, a few miles west of Chicago, was so low that in-many places one could travel across on the limestone bed, a thing before impossible. Along the banks of this stream Orthoptera appeared uneasy and much affected by the heat prevailing at the time. To the southeast and southwest, the directions from which the Grouse Locusts were blown, for miles the broad stretch of marshes, sloughs, small streams, ponds and lakes were dried, changing decidedly the topography of the districts. The effect upon animal life was to cause the shifting about of many kinds. The young grasshoppers, unusually favored, passed on to maturity aided by a scarcity of birds, their natural enemy, moreover, circumstances on every side being favorable, allowed excessive numbers to develop. Multitudes infested the regions where usually a few existed. By late fall the soil was baked by the heat, giving rise to a difficulty in finding a suitable place to deposit their eggs. Later, still further changes were enacted, for those habits ordinarily sedentary, now took on a tendency to be nomadic. Simultaneously, a kind of restless irritation took possession of the insect. Rising in the air in short flights to rid themselves of distress, aimlessly they pursued these movements through the day seeking for shelter. Ere long, a wind rushing in to take the place of the rarefied air, moving upward, bears off to distant points those caught up in its irresistible powers. Upper air currents may blow from three to twenty miles an hour, so basing an estimate on these grounds, a day's flight may be approximated at from twenty to one hundred miles. When subjected to a test the Grouse Locust's flight, ordinarily, is quite prolonged, being swift and noiseless. Referring again to the map Fig. 4, (shaded portion) an idea may be gained of the local flights of this little locust. If the furthest point be placed at one hundred miles distant from Chicago, the local point of observation, taking into consideration also the specimens found, the section of northeastern Illinois including the Kankakee River and its branches, the outlying marshy districts, various streams, ponds and tributaries of the Illinois River and the section

swept as shown on the shaded portion of the map in the north western corner of Indiana, contributed specimens to the flights. While more or less speculative, this paper is a step toward establishing a knowledge of the migrations in the Grouse Locust, of which little has been said by previous writers.

EXPLANATION OF PLATE, No. XIII.

Fig. 1, 2 and 3, Tettigidea lateralis Say, all natural size; from nature.

Fig. 1. Female with wings extended.
Fig. 2. Seen from above.
Fig. 3. Side view.
Fig. 4. Map showing flights of T. lateralis in 1893. Clouded area indicating supposed habitat and section covered by the flights.
[c]. Chicago, local point of observation.

Chicago, Feb., 1894.

A GLACIAL ICE DAM AND A LIMIT TO THE ICE SHEET IN CENTRAL OHIO.

BY W. G. TIGHT.

The great continental glacier of the Plistocene will ever present many interesting problems to the student of those times. Its effects may be grouped under two heads; first, the general and widespread results of glacial action, and second, the local and minor effects produced by the action of local forces.

Believing that a careful study of these limited phenomena will help to illustrate some of the larger problems and enable us to gain a better understanding of the geological history of Plistocene times, the liberty is taken to present a few points of surface geology of a very limited region. It is hoped, however, that the accompanying map and sections will prove of interest.

Licking County lies near the center of Ohio, and is drained by the Licking River, which is formed at Newark by the confluence of three streams, The North and South Forks and Raccoon Creek. These streams form a hydrographic basin which is very nearly co-extensive with the county lines. The Raccoon Creek and North Fork rise in the western and northern portions, which are rather high lands; they flow through broad and open valleys, ranging from one-half to one mile in width, between the Waverly hills.

The valleys are filled with drift to a depth of 100 to 150 feet, increasing in depth toward their lower portions until at Newark the gas well borings show a valley filling of over 300 feet. These two streams are of rapid fall, ascending 250 to 350 feet in the 40 to 50 miles of their lengths.

The South Fork rises on high ground in the south-western portion of the county, flows south and east to near the Licking Reservoir, which lies about 125 feet above Newark, from this point the watercourse is almost due north to Newark.

Along the east side of the North Fork, the hills rise rapidly to an elevation of about 250 to 300 feet, as they also do along the east side of the South Fork. Standing on these hills and looking west the country appears to gradually rise, but no very high hills are visible in this direction. A level, however, reveals the fact that the land to the west is nearly as high, but is so filled in with drift that only the tops of the hills appear above the general level.

In a few words, then, the conditions are these: waters flowing from the north, west and south, meet at near the center of the county and start due east, flowing a few miles over a broad flood plain, and then plunging directly into the hills of the eastern portion of the county and finally reach the Muskingum at Zanesville.

As the Licking River leaves the open plain it enters the hill country in a narrow gorge with perpendicular walls 50 to 100 feet high, and the hilltops, only a few hundred feet back on either side, rise 300 feet higher. This gorge is commonly known as the Licking Narrows, and is the subject of this sketch.

For about the first mile of this narrow cut there are two or three large curves, but the gorge is on an average about 500 feet wide, and confines the river in narrow limits. The Baltimore and Ohio Railroad makes many rock cuts in order to get along on the south side, and there is scarcely room for the towpath of the canal on the north side. The canal is in the river through this gorge.

The left-hand margin of the map, plate XIV, represents the river at the center of the last curve of this mile of gorge. The walls at X are 45 feet high and overhanging, showing a large amount of undercutting on the curve. The heavy shaded line represents the outcrop of the Waverly or Logan Conglomerate, and wherever exposed presents an escarpment with an elevation represented by the figures on the contour lines.[1]

The last curve of the gorge referred to above, extends to about O and P, at which point the curve of the next sigmoid

---

[1] All vertical measurements are from the water level in the river, which is constant on account of the dam below.

begins. The gorge runs on past L m to the center of the next curve at OO, completing the curve at the point n.

The river, however, does not follow this course, as will be seen by following the shaded portion which represents the present river course, but turns at a right angle and runs through a rock cut 150 feet wide, with overhanging walls at both g and c′.

Just south of c′ the railroad has made a rock cut 45 feet deep on a very sharp curve in order to get through the gorge. The rock g, known as Black Hand Rock, stands out with a bold front 45 feet high and 250 feet long next to the river, where the tow-path of the canal had to be blasted out. The rock slopes on its top toward the north, and presents an overhanging wall about 20 feet high on that side.

Within the large open area of the unoccupied curve north of g there is a low mass of rocks presenting the form indicated at m, with a vertical rock exposure 10 feet high on the south side of the mass and gradually falling off into the lower channel OO, which is only 4 to 5 feet above water level. At n, and between g and m, are ponds of water on a level with the water of the river. The channel, between g and m, is about 70 feet wide, while that between m and L is 200 feet also between g and the vertical cliff H, on the east side of the channel, is 290 feet.

Continuing the large curve L, OO, n southward to R, there is, on the east side, a long, straight bluff, SS, 45 feet high at the present river front, and gradually decreasing to about 8 feet at its southern end. On the high ground between X and this channel there is a light drift covering as indicated by the dotted portion. This drift covers the west wall of the channel except at Y, where the rock is exposed. At YY there is no escarpment, but the high hill presents a very distinct curve as is shown by the contour lines. Between Y, YY, Z and the double cross, there is a low drift plain with a form shown by the contours. The river does not follow this low gap which is nowhere over 15 feet above its present level, but has cut a channel through the rocky spur H and S, 300 feet wide and 45 feet deep to present water level. The river here has about 30 feet of water.

At K is a rock with 25 feet vertical front, and at T a rocky projection 45 feet high, through which the river has also cut, while there is an open channel 350 feet wide between K and HH, obstructed only by a gravel trail 15 feet high, extending from K to a low rocky exposure at KK.

The rocks S and T are also separated by a channel about 250 feet wide, presenting vertical walls for a short distance back from the river, and indicated farther south by a depression in the drift filling.

At FF is a high hill with a rock cliff 25 feet vertical. At u u there is a low rock wall which is extended to the dam at F. Wells in the drift terrace south of w show a buried channel there 50 to 75 feet deep.

By tracing out the curves and sigmoids indicated by these rocky walls, evidence is found for two distinct rock gorges, besides the one occupied by the present river, as shown by the heavy, dotted and broken lines respectively.

To make these data as clear as possible, five sections drawn to scales are presented in plate XV. These sections are taken along the lines bearing the same letters on the map and in the same position. The continuous, interrupted and crossed lines represent the courses of the rocky gorges, while the dotted portions represent the estimated depths of the drift-filled channels.

The interpretation of this peculiar locality is by no means certain. We venture an explanation which, in the light of Prof. I. C. Russel's investigations on existing glaciers, seems to me quite possible. There is abundant evidence for believing that the preglacial drainage of Licking County was to the south, and that a great morainic dam backed the water up until it broke over a col into the Muskingum basin.[2]

This col was at the point represented by C at the extreme left of plates XIV and XV. On each side of this low divide there was a ravine cut into the Waverly Conglomerate.

As the water rose over the divide and began to cut it down, the gorge produced by this cutting to the west of the point C

---

[2] Full description of evidence for these conditions will be found in Bulletin of Scientific Laboratories of Denison University, Vol. VIII, Pt. 2.

conformed exactly to the pre-existing ravine running in that direction, as this ravine would represent continuously the lowest point in the divide, hence we find the upper part of the present gorge showing no marked changes in its position.

The ravine on the down slope toward the east, however, whose outline is represented on plate XIV by the dotted line, and on plate XV by the crossed line, fared quite differently. A large volume of water suddenly attempted to occupy a small ravine. The result was that the first curvature was greatly increased and a great undercut made at X. Deflected from this point it struck the opposite or left bank of the ravine at m, and as it cut farther back into the great curve at OO, it also cut deeper and a small remnent of the left bank of the original ravine was left at m. The outline of this channel is represented by the broken line.

After making the curve at OO where considerable undercutting is also shown, the waters took a straight shoot south into the old ravine again.

At the south end at YY, the old ravine, as shown by the dotted lines, made another sharp curve similar to the one at g, and passed north between S and T to another curve at H H, thus making the next loop of the sigmoid which passed southeast through the point u.

Since the rush of glacial waters was not able to make the short turn at Y Y, and since the original surface level was lower than at H, they broke over the divide and made a new cross channel tending north-east in the direction Z u, and chocked up the old ravine between S and T with sediment. As the lower level was reached and the velocity checked, the lower courses of the intersected ravine were filled up with material cut from the gorge above. Evidence of these buried channels is found in many wells in the village of Toboso, just south of the river dam, which is across the present river at F.

There yet remains the great question, Why the river ever left this second channel which it had cut out at such a great depth and made a new one for itself straight across the rocky barriers at g c′, H S, and KT. If these were at the ends of the loops, or if the old channel was anywhere obstructed with

drift, the explanation would be more simple. As it is, there seems to be but one solution to the problem to suggest, and we believe the facts point very strongly toward its support. This region is just on the eastern border of the Scioto lobe of the ice sheet. No glacial till is reported south or east of this point in Ohio. Does it not seem reasonable then that the great ice front or a local spur of it extended to this point and presented a front along a line represented by the north bank of the river in the line of L, m, g, n, H, K, and F, and remained there long enough for the river waters deflected at X to strike this ice barrier at L m, and, deflected along its front, to cut through the narrow and jointed rocky spurs at KT, then at HS, and last at g c′. If this is true, it will serve as a point in evidence of the probability of ice dams and a point to fix a limit to the ice sheet itself.

For fuller elaboration of the data of this region and other facts in evidence of the very near position of the ice front, see Bulletin of the Scientific Laboratories of Denison University, Vol. VIII, Pt. 2.

EDITORIALS.

—The U. S. National Academy of Sciences has been in a state of paralysis for now two years in the matter of electing members, after having been unable to fill its vacancies for a considerably longer period. This is not due to the lack of suitable candidates, but rather owing to the impossibility of concentrating a sufficient number of votes on any one candidate to elect him. This is in turn due to the fact that there is a disproportionate number of members devoted to the physical sciences, as compared with those devoted to the natural sciences. In the present membership there are, according to a committee of the society, fifty-eight members devoted to the physical, and thirty-one members who represent the natural sciences. It is natural that under such circumstances, the members of the latter class should refuse to add to the members of the former class. It is true that of the seven candidates presented at the election which has just failed, four represented the natural, and three the physical sciences. But the gentlemen present who represent the physical sciences could not be prevailed on to elect an additional member of the division of natural sciences. This result is probably due to a want of concerted action, rather than to an intentional desire to continue the present disproportion between the classes. It is also due in part to the vote of members who do not attend the meetings, and who thus fail to receive information as to various points at issue. The preponderance of any one class naturally tends to perpetuate itself, and its effect is now so conspicuous that the necessity for some change in the mode of elections is obvious.

It is proposed to meet the difficulty by dividing the Academy into classes, each of which is to have a fixed membership, so that deficiencies may be known and filled. Such a system exists in the academies of most countries, and it materially aids in securing a just representation. The system should not, however, be too complex, since it is impossible to fix the correct proportion of membership of any of the special branches of science, which shall be always applicable. A few large divisions, whose cultivators for obvious reasons stand in a generally definite proportion to each other, or to the Academy, is about as much as is practicable in this direction. The committee already referred to, proposes that the Academy be divided into six classes, three of which embrace physical sciences, and two natural sciences, and one includes sciences which cannot be classed under either head. This

classification tends to perpetuate the disproportion already referred to; omits reference to some sciences; and makes no distinct division for applied science. We now refer to a letter addressed to the committee, which appears in the department of Scientific News this number of the NATURALIST, in which the following division is proposed: Class I.—Physical Sciences, 35 members; Class II.—Natural Sciences, 35 members; Class III.—Anthropological Sciences, 15 members; Class IV.—Applied Sciences, 15 members. The sciences included in each of these classes are enumerated in the letter in question.

—A bill has been recently introduced into Congress, providing for the establishment of a "National Academy" of twenty-five members. Of these Congress is to appoint the first five members, and these are to appoint the other twenty. These twenty-five are to represent "literature, science, fine arts and invention." We understand that Gen. Lewis Wallace has drawn up the bill.

The sponsors of this project appear to be unaware of the existence of the National Academy of Sciences of one hundred possible members. They also display an extraordinary exclusiveness in entertaining the supposition that the departments of human effort mentioned in the bill can be properly represented by only twenty-five men. Taking the National Academy of Sciences for granted, it might be supposed that an Academy of Arts might be similarly constituted. In such a case, membership, as in the Academy of Sciences, would be awarded on account of original work done. Literature, Music and the Fine Arts would be encouraged by such an organization, were the qualifications for membership and the number of members strictly defined. The difficulty in doing this, and in applying the rules in the concrete, would be greater in the case of the arts, we apprehend, than in the case of the sciences. It is also quite probable that fifty names, rather than one hundred, would embrace the list available at the present time in this country.

It is hardly possible that the bill now before Congress can become a law in its present shape. The scientific element must be eliminated as being already provided for. The best literary men and artists of the country must decide whether such a body could be so constituted as to be truly representative of the best work or not. Geographical claims, so dear to the American heart, must be ignored in this matter, as it is in the Academy of Sciences; and the usual preference of most people for their friends will be an ever present difficulty to be met and overcome. On the whole, however, we suspect that such a body, properly

protected, would be an encouragement to original production in the arts, as the Academy of Sciences is to those engaged in the pursuit of scientific research.

—The recent celebration at Jena, in commemoration of the sixtieth birthday of Professor Ernst Haeckel, was a deserved compliment to a great naturalist. The range of Professor Haeckel's work covers the three fields of usefulness possible to the naturalist, viz.: special work, generalization, and popularization. His well known researches on the Radiolaria, sponges, corals and Medusæ are monuments of industry and skill. His generalization of the phenomena of the earliest embryonic stages is the frame-work of embryology. His speculations as to the phylogeny of the Vertebrata have been often confirmed by paleontology. His delightful Travels in Ceylon have brought him before a wide and interested public.

PLATE XIII.

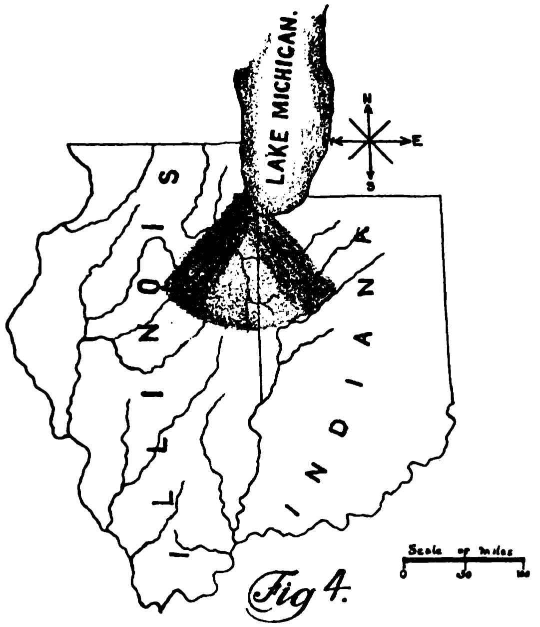


Fig 4.

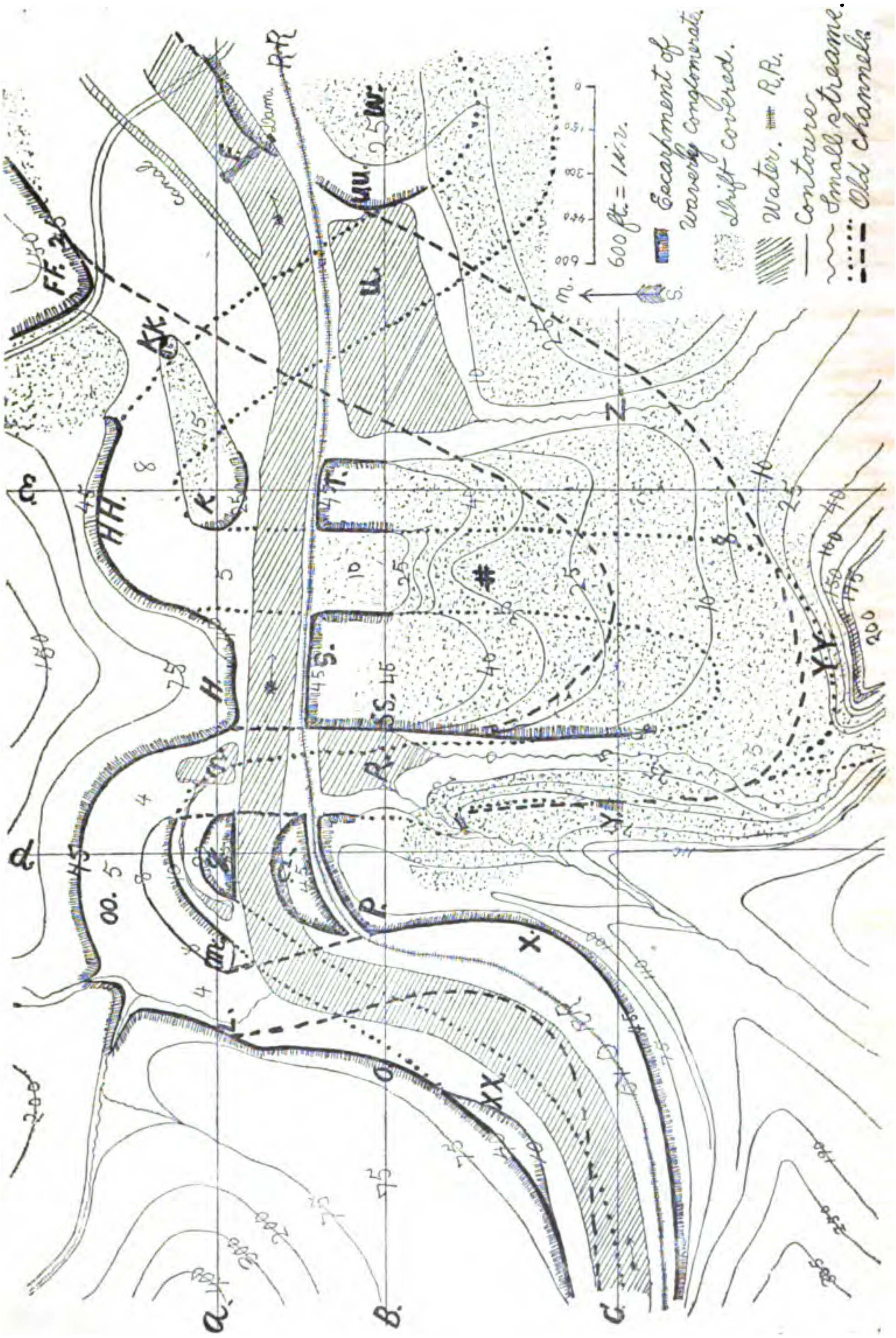
Fig. 1.

Fig. 2.

Fig. 3.

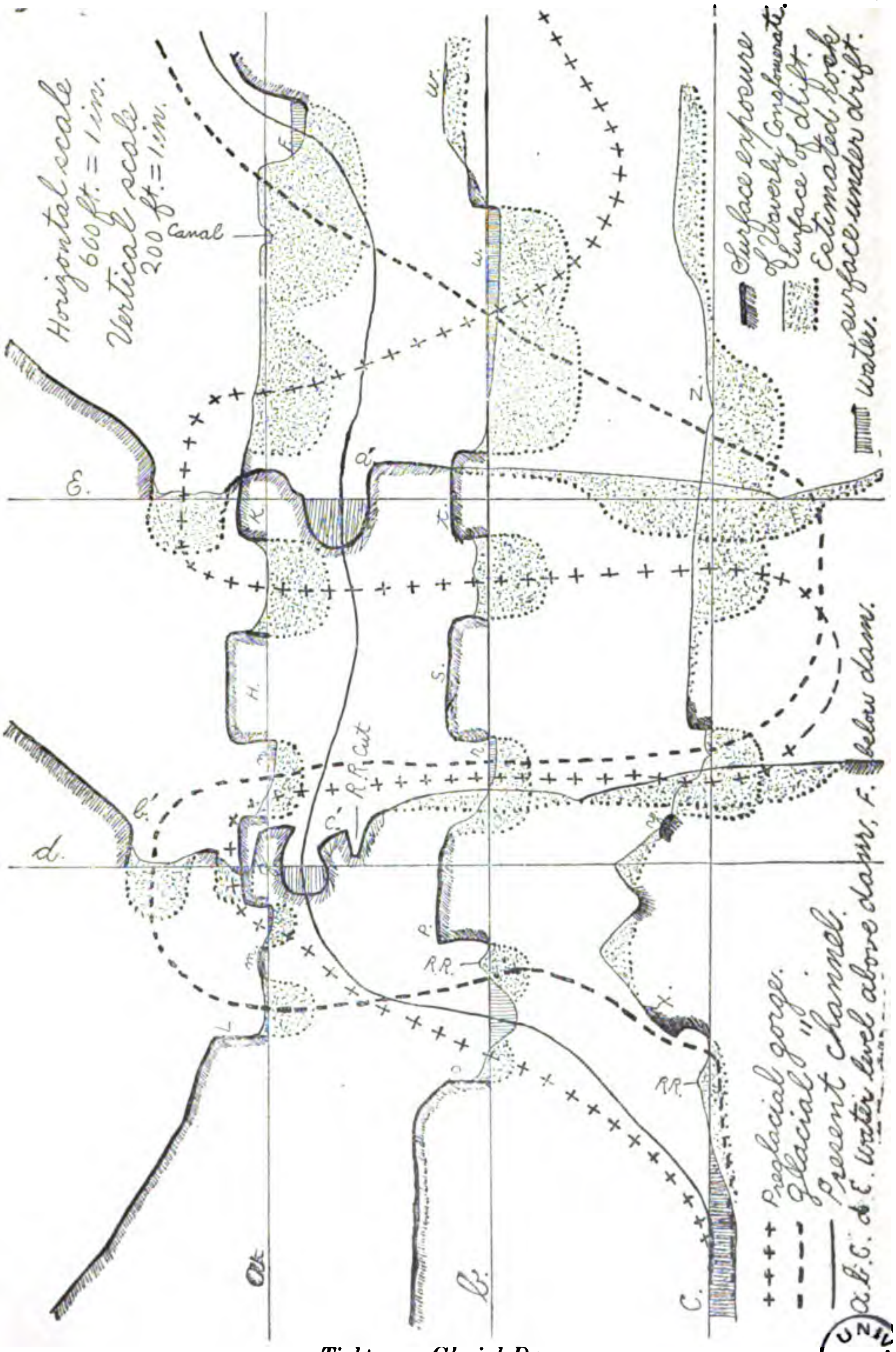
Tettigidea and its Migrations.

PLATE XIV.



Tight on a Glacial Dam.

PLATE XV.



Tight on a Glacial Dam.

RECENT BOOKS AND PAMPHLETS.

Bollman, C. H.—The Myriapoda of North America. Bull. No. 46, U. S. Natl. Mus. From the Smithsonian Institution.

Bean, T. H.—Description of a new Blennoid Fish from California. Extr. Proceeds. U. S. Natl. Mus,. Vol. XVI. From the author.

Beecher, C. E. and C. Schuchert.—Development of the Brachial Supports in Dielasma and Zygospira. Extr. Proceeds. Biol. Soc. Washington, Vol. VIII, 1893. From the authors.

Bulletin No. 26, 1893, Agric. Exp. Station of the Rhode Island College of Agri. and Mech. Arts.

Bulletins Nos. 93, 1893, and 94, 1894, North Carolina Agricultural Experiment Station.

Campbell, M. R.—Paleozoic Overlaps in Montgomery and Pulaski Counties, Virginia. Extr. Bull. Geol. Soc. Am, Vol. 5, 1894. From the Society.

Chadwick, J. W.—The Heterodox Hell—Science and a Future Life—Boston, 1894. From the author.

Dall, Wm. and J. Stanley Brown.—Cenozoic Geology along the Apalachicola River. Extr. Bull. Geol. Soc. Am., Vol. 5, 1894. Form the Soc.

First Biennial Report of the Maryland State Weather Service for 1892 and 1893. From the Director.

Fleishmann, A.—Die Grundform der Backzähne bei Säugethieren und die Homologie der einzelnen Höcker. Sitzungsb. der Königlich preuss. Akad. der Wissensch. zu Berlin, 1891. From the author.

Gibson, A. M.—Report on the Coal Measures of Blount Mountain, with Map and Sections. Montgomery, Ala., 1893. From the Alab. State Geol. Surv.

Gilbert, G. K. and B. S. Lyman.—A Joint Discussion. The Name "Newark" in American Stratigraphy. Philadelphia, 1893. From the authors.

Goodrich, E. S.—On the fossil Mammalia from the Stonesfield Slate. Extr. Quart. Journ. Micros. Sci., Vol. 35.

Haines, R.—Examination of Spring Waters in Fairmount Park.——A Remarkable Artesian Well-water.——Normal Chlorine in Spring Waters. Extrs. Proceeds. Chem. Sec., Franklin Institute Phila., 1894.

Harle, E.—Les Brèches á Ossements de Montoussé, Suivi d'appendices sur des Equidés, Rhinocéros, Bovidés, et Marmottes Quaternaires du Sud-Ouest de la France.——Le Repair de Roc-Traücat, et Notes sur des Mégacéros, Castors, Hyènes, Saigas, etc., du Sud-Ouest de la France. Extr. Compte Rendu de la Soc. d'Hist. Nat. de Toulouse, 1892. From the author.

Hobbs, W. H.—On a Rose-colored Lime and Alumina-bearing variety of Talc. Extr. Am. Journ. Sci., Vol. XLV, 1893.——The Geological Structure of the Housatonic Valley lying east of Mt. Washington. Extr. Journ. Geol., Vol. I, 1893. From the author.

Johns Hopkins Hospital Reports. Report in Gynecology, II, Vol. III, 1894.

Kemp, J. F.—Gabbros on the western shore of Lake Champlain. Extr. Bull. Geol. Soc. Am., Vol. 5, 1894. From the Society.

List of Dredging and Shore Stations, S. U. I. Bahama Expedition, 1893.

LYDEKKER, R.—On the Jaw of a New Carnivorous Dinosaur from the Oxford Clay of Peterborough. Extr. Quart. Journ. Geol. Soc., Aug., 1893.

LYMAN, B. S.—Age of the Newark Brownstone. Extr. Proceeds. Amer. Philos. Soc., Vol. XXXIII, 1894. From the author.

BARCENA, M.—Informe sobre el Estado actual del Volcan de Colima, Mexico, 1887. From the author.

MERRIAM, C. H.—Descriptions of eight new Ground Squirrels of the genera Spermophilus and Tamias from California, Texas and Mexico. 1893.

——The Yellow Bear of Louisiana, *Ursus luteolus* Griffith. Extrs. Proceeds. Biol. Soc. Washington, 1893. From the author.

MITCHELL, C. P.—The Enlargement of the Sphere of Women, London, 1892. Williams and Norgate Pub. From the author.

NELSON, E. W.—Description of a new species of Arvicola, of the Mynomes Group, from Alaska. Extr. Proceeds. Biol. Soc. Washington, Dec., 1893. From the author.

ORR, H. B.—A Theory of Development and Heredity. New York, 1893. Macmillan and Co., Pub. From the Pub.

Proceedings at the Formal Opening of the Engineering Building of the Pennsylvania State College, Feb. 22, 1893.

PROSSER, C. S.—The Devonian Section of Central New York along the Unadilla River. Extr. Twelfth Ann. Rept. New York State Geologist for 1892. From the author.

QUIMBY, C. E.—The Pneumatic Cabinet in the treatment of Pulmonary Phthisis. Extr. Internatl. Med. Mag. Jan., 1893. From the author.

RANSOME, F. L.—The Eruptive Rocks of Point Bonita. Extr. Bull. Dept. Geol. Univ. of California, Vol. I, 1893. From the author.

RILEY, C. V.—Some Intercalations of Plants and Insects. Extr. Proceeds. Biol. Soc. Washington, Vol. VII, 1892.——The First Larval or Post-embryonic Stage of the Pea and Bean Weevils. Extr. Canadian Entomol., Vol. 24, 1892.——Is Megastigmus phytophagic?——Parasitism in Insects. Extr. Proceeds. Entomol. Soc., Vol. II, 1893. From the author.

ROBERTSON, C.—Flowers and Insects, I to XI, inclusive. Extrs. Botanical Gazette, Vol. XIV, 1889, Vol. XVIII, 1893, and Trans. St. Louis Acad. Sci., Vol. V and VI.——North American Hymenoptera. Extr. Trans. Am. Ent. Soc., 1891 and 1893. From the author.

RÜTIMEYER, L.—Die eocänen Säugethiere von Egerkingen. Separatabdruck aus den Verhandlungen der Naturf. Gesell. zu Basel, Bd. X, Heft 1, 1892. From the author.

SCHUCHERT, C.—On the development of the Shell of *Zygospira recurvirostra*. Extr. Proceeds. Biol. Soc. Washington, Vol. VIII, 1893. From the author.

SHALER, N. S.—Plistocene Distortions of the Atlantic Sea-coast.——Relation of Mountain Growth to Formation of Continents.——Phenomena of Beach and Dune Sands. Extr. Bull. Geol. Soc. Am., Vol. 5, 1894. From the Soc.

SHUFELDT, R. W.—On the Taxonomy of the Swifts and Humming Birds. A Rejoinder. Extr. Ibis, Jan., 1894. From the author.

STILES, C. W. AND A. HASSALL.—A Revision of the adult Cestodes of Cattle.

Sheep and allied animals. Bull. No. 4, Bureau of Animal Industry, U. S. Dept. Agri., 1893. From the Dept.

TAYLOR, T.—Report of the Microscopist. Extr. Rept. Sec. Agri. for 1892.——Food Products, II, III. Reprint Rept. Sec. Agri. for 1890.——Eight edible and twelve poisonons Mushrooms of the United States.——Improved methods of distinguishing between pure and fictitious lard.——Four edible Mushrooms of the United States. Extr. Rept. Sec. Agric., 1890. Second revised Ed., Washington, 1893. From the U. S. Dept. Agric.

TROUESSART, E.—Note sur les Acariens marins (Halacaridæ) dragués par M. P. Hallez dans le Pas-de-Calais. Extr. Rev. Biol. du Nord de la France, T. VI, 1893–94. From the author.

WHITEAVES, F. F.—Descriptions of two new species of Ammonites from the Cretaceous rocks of the Queen Charlotte Islands. Extr. Canadian Rec. Sci., Oct., 1893. From the author.

WOODWARD, A. S.—On the Dentition of a gigantic extinct species of Myliobatis from the Lower Tertiary formation of Egypt. Extr. Proceeds. London Zool. Soc., June, 1893.——On some Teeth of new Chimæroid Fishes from the Oxford and Kimmeridge Clays of England. Extr. Ann. Mag. Nat. Hist., July, 1892.

WOODWARD, A. S—On the genus Anomœodus.——Note on a Case of Subdivision of the Median Fin in a Dipnoan Fish.——Further Notes on Fossil Fishes from the Karoo Formation of South Africa.——On some British Upper Jurassic Fish remains, of the Genera Caturus, Gyrodus and Notidanus. Extrs. Ann. Mag. Nat. Hist., 1873. From the author.

VERY, F. W.—The Hail Storm of May 20, 1893. Extr. Am. Meterol. Journ., Oct., 1893. From the author.

RECENT LITERATURE.

The Woods Holl Lectures.[1]—It is with pleasure that we welcome the second of the series of lectures delivered at the Woods Holl Laboratory, for they deserve a larger audience than that for which they were especially prepared. In the present volume we have ten lectures, each adequately illustrated, most of which are devoted to the presentation of the newest thought upon subjects which are most prominent in the biological world to-day. They are, moreover, not résumés of others' work but actual contributions to knowledge by original investigators. In his lecture on the "Mosaic theory of Development," Professor E. B. Wilson, admitting that the extreme form of this theory is untenable, endeavors to show that in a modified shape it contains elements of truth, "that we may consistently hold with Driesch that the prospective value of a cell may be a function of its location and at the same time hold with Roux that the cell has, in in some measure, an independent power of self determination due to its inherent specific structure." Professor E. G. Conklin discusses certain phenomena in the fertilization of the ovum of Crepidula, a form which is especially favorable for the study of the archoplasmatic structures, which he maintains are even more important in the phenomena of impregnation and mitosis than the nucleus, taking as they do the initiative in all the wonderful manifestations of fertilization and cleavage. Further he advances the thesis that the nucleus and especially the chromatin is not of necessity the sole bearer of heredity, a position, which if proved to be true, destroys the whole fabric of Weismann's evolution, as at present constituted.

The third lecture by Professor Jacques Loeb, of Chicago University is upon some facts and principles of what he terms physiological morphology. First he deals with heteromorphosis, that is, describes his experiments with certain Hydroids, there, by reversing the positions, etc., he was able to make roots produce polyps and the free end to grow roots. Next he outlines his experiments with other forms in which there was marked polarity. The third subject is the effect upon certain forms of a change in the density of sea water, while the fourth deals with the production of double and multiple monstrosities in sea urchins, by putting them a short time into diluted sea water and then

---

[1] Biological Lectures delivered at the Marine Biological Laboratory of Woods Holl in the summer session of 1893. Boston, 1894. 8°. pp. 242, $2.15.

back into normal. In the concluding section, all life phenomena are referred back to chemical processes.

Under the title Dynamics in Evolution, Professor Ryder reiterates his mechanical ideas, explains the changes in form of an amœba by differences of surface tension and this again by chemical action. He has no sympathy with "biophores" and "gemmules" and thinks that experimental investigation in embryology will make no firm progress until the mischievous influences of those speculations which deal with "germ plasms" and the like have been entirely eradicated from the present generation.

Dr. Watase, treating of the nature of cell organization, thinks it not improbable that in the cell we have a symbiotic structure, the nucleus and the cytoplasm living together in a way analogous to that presented by the algæ and the fungus in the lichen. Professor Whitman's lecture on the Inadequacy of the Cell Theory of Development is most suggesitve, but is so condensed as to be beyond any adequate abstract. In a word it is that in our discussions of the cell as a unit, especially in the experimental embryological researches, the tendency has been to regard the cell as all in all, while in reality the whole organism is the entirety.

The thesis which Dr. Howard Ayers maintains in his study of the Pacific Hagfish *Bdellostoma dombeyi*, are that this form is very variable and that the number of gill slits cannot be used as a criterion for separating genera and species; further that it is a primitive rather than a degenerate type; and lastly that a study of the ears of this animal show that these organs cannot be considered as organs of equilibration.

The next two lectures touch upon the Botanical side. Dr. W. P. Wilson discusses the influence of external conditions on plant life and presents an essay which goes far toward showing that such striking acquired characters as the knees of the bald cypress are not inherited but will disappear in a single generation with changed conditions, and that the same is true of the remarkable roots of the Black mangrove of Tropical America. The other botanical lecture, by Professor J. Muirhead Macfarlane, treats of irrito-contractility in plants, in which he shows that this phenomenon is much more common than is ordinarily supposed, but that there is usually a latent period and that in many instances the stimulus has to be repeated before marked manifestations are produced.

The last lecture—upon the Marine Biological Stations of Europe by Dr. Bashford Deane—is familiar to our readers. The volume closes

by a general statement, by the Director, Professor C. O. Whitman, of the work and aims of the laboratory from which we learn that already 75 papers have been published, the direct outcome of the laboratory in its six sessions.

The volume is well printed and we look for a large sale for it, for it certainly should be in the hands of every one who wishes to keep himself informed of the present tendencies of biological science.

Report of the United States Fish Commissioner for 1889-91.[2]—This volume contains in addition to the official report of the Commissioner, the results of inquiry respecting Food-fishes and the Fishing grounds of the United States, by Richard Rathbun, and a statement of the Methods and Statistics of the Fisheries, by H. M. Smith. together with six papers published as appendices to the report. Among these is Hæckel's "Plankton-Studien," A Comparative Investigation of the Importance and Constitution of the Pelagic Fauna and Flora, translated by George W. Field.

Mineral Resources of the United States, 1892.[3]—This volume shows the progress made in the development of the mineral products of the United States in 1892. The statistical tables are carried forward from former reports to the close of 1892, but the descriptive matter has been brought up to a late date in 1893.

[2] Report of the United States Commissioner of Fish and Fisheries for 1889-91. Washington, 1893.

[3] Mineral Resources of the United States for 1892. David T. Day, Geologist in Charge. Washington, 1893.

General Notes.

GEOGRAPHY AND TRAVELS.

The Grand Falls of Labrador.—For many years vague reports of a great waterfall in Labrador near the head waters of the Grand River have induced men to explore the interior plateau of this region. but no satisfactory account has been given of the appearance of the "Falls" until the recent publication of the results of an exploration undertaken by Mr. Henry G. Bryant of Philadelphia to verify the reports as to the height and location of this natural wonder.

In company with Prof. Kenaston of Washington, D. C., Mr. Bryant arrived at Rigolet in Hamilton Inlet, July 23d, where they embarked on a small schooner which carried them to the head of the interior basin known as Melville or Grosswater Bay. Here Mr. Bryant tried for Indian coöperation in his enterprise but could not overcome their superstitious fears. They firmly believe that death will soon overtake the venturesome mortal who dares to look upon the mysterious cataract. The party that finally started up the Grand River on August 3d consisted of Mr. Bryant, Prof. Kenaston, John Montague, a young Scotchman, and Geoffrey Ban, a full-blood Eskimo. The trip was made in a strong river boat eighteen feet in length and they took with them a canoe for use in the upper reaches of the river. By noon of the second day the party reached Muskrat Falls, where a chain of hills encroaches the bed of the river, contracting the channel and presenting a rocky bulwark, through which the stream has forced its course. The drop of the falls was ascertained to be thirty-six feet. Here was necessitated the first carry, a tedious operation which occupied a day and a half. The subsequent advance of about 175 miles up the river was by the method known as "tracking." That is, a rope was tied to the gun-wale just aft the bow. To the shore end broad leather straps were attached. This constituted a harness for three of the men who tugged away along the rocky back while the fourth man, by means of an oar lashed to the stern, steered a devious course among the rocks and shallows of the river. Sandy banks and glacial boulders insecurely lodged afforded a precarious footing for the "team," and stretches of rugged cliffs exercised their ingenuity in making progress. Wading in the water was often the only resource.

On the fourth day Porcupine Rapids was reached, a distance of fifty-seven miles from the mouth of the river. Here was a notable increase in the size of the firs and spruces. Deposits of magnetic iron ore were observed on the banks of the river. The next day the travellers passed through a widening of the river known as Gull Lake. This is a favorite resort of the Canada goose and its waters contain large numbers of white-fish, pickerel and suckers. Above the lake the valley of the river contracts gradually; the sandy terraces disappear, and sloping banks, strewn with erratics, are encountered for many miles. The Gull Island, Horseshoe, Minnipi and Mouni Rapids were conquered in turn. In the swollen condition of the river, the struggle with these wild rapids was long and stubborn. Mouni Rapids extend over a longer distance than any of the others, and aneroid readings show a greater drop here in the bed of the river than at any other point. It was here that the travellers met with an awkward adventure, which Mr. Bryant relates in the following graphic manner.

"We were approaching a rocky point past which the water dashed with angry violence. It was our custom on reaching such a place to first detach the canoe, and then shove out the boat obliquely from the still water to allow her bow to fairly meet the swifter current. On this occasion, while Montague and I, facing up stream were waiting on the bank above for the signal to advance, the boat, through some carelessness, was pushed out from the quiet eddy squarely into the swift water. The full force of the torrent struck her abeam, and away she swept down the stream like a thing possessed. Taken unawares, no time was given to throw off the leather straps from our shoulders, and instantly we were thrown from our feet and dragged over the rocks into the river by the merciless strength of the flood. Most fortunately for me, the circular strap slipped over my head as I was being dragged through the water. Montague's also released itself, and the runaway sped down stream a quarter of a mile before it was stopped. On clambering up the bank I found Montague stunned and bleeding from a scalp wound. Aside from some abrasions of the skin, I was none the worse for my shaking up, and after a brief delay Montague revived and we resumed our 'tow-path' exercise."

Lake Wanakopow was reached August 20th. This romantic sheet of water, less than a mile in width but 35 miles in length, is surrounded by low mountains of granite and gneiss, from whose cliffs and wooded headlands cascades leap into the lake, their silvery outlines contrasting with the environment of dark evergreen foliage. A sounding taken near the middle shows a depth of four hundred and six feet. Mr.

Bryant considers this narrow elevated basin to be of glacial origin, the presence of great numbers of boulders and the rounded appearance of the hill summits pointing to a period of ice movement.

The middle of Lake Wanakopow marks the limit of Mr. Holme's exploration. On his map he places the Grand Falls thirty miles above the head of the lake, with the river entering the lake from the west. Mr. Bryant found, however, that the river enters from the southwest, and the distance from the lake to the rapids below the fall is fifty-three miles.

Finding it impossible to draw the boat through the wide shallow rapids which they afterwards found extended for twenty-five miles before the fall, the explorers resolved to find an old trail they had heard of from a reliable Indian at the Northwest River Post, which leads from this point on the river through a chain of lakes on the tableland, thence to the waters of the Grand River some miles above the Grand Falls. The plan was to follow the old trail for several days then leave it and strike across country in the direction of the river.

A search of three days for the trail was at last successful and the party advanced across five lakes and four "carries." At the northwestern extremity of the sixth lake they left the trail and prepared for the tramp across country, which, according to Mr. Bryant, is of the most desolate character. It is undulating, sparsely covered with stunted spruce trees, Labrador tea-plants, blue-berry bushes, etc., among which great weather-worn rocks gleam, while on all sides white patches of caribou moss give a snowy effect to the scene. Shallow lakes reflect the fleeting clouds, their banks lined with boulders, and presenting a labyrinth of channels and island passages. Low hills rise at intervals, but the general effect of the landscape is that of, flatness and monotony. No living thing was encountered. Just before sunset a column of mist rising like smoke against the western sky proved the accuracy of their reckoning, but it was impossible to reach the river that night.

The next day, Sept. 2d, after a rough march over rocks and bogs, they emerged from the forest near the spot where the river plunged into the chasm with a deafening roar. The following description by Mr. Bryant is so vivid that we cannot refrain from quoting it entire.

"Standing at the rocky brink of the chasm, a wild and tumultuous scene lay before us, a scene possessing elements of sublimity and with details not to be apprehended in the first moments of wondering contemplation. Far up stream one beheld the surging, fleecy waters and tempestuous billows, dashing high their crests of foam, all forced onward with resistless power towards the steep rock, whence they took their wild leap

into the deep pool below. Turning to the very brink and looking over, we gazed into a world of mists and mighty reverbations. Here the equisite colors of the rainbow fascinated the eye, and majestic sounds of falling waters continued the pean of the ages. Below and beyond the seething caldron the river appeared, pursuing its turbulent career, past frowning cliffs and over miles of rapids, where it heard 'no sound save its own dashings'. The babel of waters made conversation a matter of difficulty, and after a mute exchange of congratulations, we turned our attention to examining the river in detail above and below the Falls."

"A mile above the main leap, the river is a noble stream four hundred yards wide, already flowing at an accelerated speed. Four rapids, marking successive depressions in the river bed, intervene between this point and the Falls. At the first rapid the width of the stream is not more than one hundred and seventy-five yards, and from thence rapidly contracts until reaching a point above the escarpment proper, where the entire column of fleecy water is compressed within rocky banks not more than fifty yards apart. Here the resistless power is extremely fine. The maddened waters sweeping downwards with terrific force, rise in great surging billows high above the encompassing banks ere they finally hurl themselves into the gulf below. A great pillar of mist rises from the spot, and numerous rainbows span the watery abyss, constantly forming and disappearing amid the clouds of spray. An immense volume of water precipitates itself over the rocky ledge, and under favorable conditions the roar of the cataract can be heard for twenty miles. Below the falls, the river turning to the southeast, pursues its way for twenty-five miles shut in by vertical cliffs of gneissic rock which rise in places to a height of four hundred feet. The rocky banks above and below the falls are thickly wooded with firs and spruces, among which the graceful form of the white birch appears in places."

Attempts to secure photographs of the falls did not meet with success, it was difficult to obtain a good point of view, and, besides, a combination of poor light and mist from the falls cause a lack of definition in the photographs.

Prof. Kenaston found by measurement that the height of the main fall is 316 feet and the vertical height of the chute is 32 feet; making the total descent from the head of the chute to the surface of the water in the chasm about 348 feet. The Grand Falls are then nearly twice as high as Niagara, and are only inferior to that cataract in breadth and volume of water.

The appearance of the sides of the gorge below the falls and the zigzag line of the river suggests that the falls have receded from the edge of the plateau to their present position, a distance of twenty-five miles. If it has taken six thousand years to cut the Niagara gorge where the water acts on a soft shale rock supporting a stratum of limestone, what an immensity of time is involved in assuming that the Grand River Cañon has had a similar history when it is remembered that the escarpment of the Labrador Falls is of hard gneissic rock.

Among the results obtained by the expedition are the measurement of the height of the Grand Falls; the determination of the altitude of the table-land of southeastern Labrador; map of the lower course of the Grand River, from compass survey; meteorological observations extending over the six weeks of the journey; botanical collections illustrating Labrador flora; ethnological collections illustrating life and customs of mountaineer Indians and Eskimos. (Bull. Geog. Club vol. I, no. 2, 1894.)

GEOLOGY AND PALEONTOLOGY.

Continuity of the Glacial Epoch.—The question of *Pre*-glacial or *Inter*-glacial erosion of the rocky gorge of the Ohio River and its tributaries is made the subject of a paper by Rev. G. Frederick Wright in the Am. Journ. Sci., March, 1894. The writer, as it is well known, maintains the former theory, and gives the following summary of the course of events connected with the Glacial period, stating more fully than has heretofore been done how those who question the long interglacial epoch can account for what has been called the moraine of the second Glacial epoch, and for the river terraces which everywhere, east of the Mississippi River, head near the moraine

"1st. The earlier portions of the Tertiary period were characterized, throughout all the northern hemisphere, by low altitude of land and a warm temperature even in close proximity to the pole."

"2d. A period of slow continental elevations of the regions which are now covered by Glacial drift, extending through some hundreds of thousands of years, was in progress late in the pliocene epoch. During this stage of events, the fiords which characterize the northern portions of both Europe and America, and the extensive rock gorges, like those of the upper Ohio River and its tributaries, were eroded."

"3d. Contemporaneously with this continental elevation at its maximum stage, and chiefly as a consequence of it, Glacial conditions characterized all the higher latitudes of North America and Western Europe. In eastern North America, the center of Glacial radiation was in the vicinity of James Bay. A land elevation of three or four thousand feet would perhaps have been sufficient to produce the Glacial conditions; but the accumulation of the Glacial ice would eventually raise the surface several thousand feet higher."

"4th. Before the climax of the Glacial period, and perhaps in consequence of its burden of ice, the glaciated area began to sink until the land was, north of the Great Lakes at any rate, several hundred feet, at least, lower than it is now. But for some time after the beginning of the subsidence of the land, the rate of accumulation of ice would be greater than that of the subsidence, so that the general level of the glacier continued to rise. Thus the maximum extension of the ice field was actually reached but a short time before the decline of the period set in."

"5th. As suggested to me by Mr. Upham, 'The frontal slope of the ice surface was then less steep than when the warmer climate, bringing the end of the Glacial period, had begun to melt away the southern border.' At the maximum of extent, the slope may be represented as terminating in a very gentle declivity, allowing some transportation of bowlders to the boundary, but not generally so steep as to produce there any well defined moraine. In the glacial recession the warm sunshine and rains were especially efficient, on a belt a few miles or a few tens of miles wide adjoining the boundary, so that when any temporary colder series of years caused a halt or slight re-advance, a moraine would be formed."

"6th. From the time the ice first entered the headwaters of the Allegheny, the Susquehanna, and the Delaware Rivers, the silting up of their channels began. This was effected largely by means of the excessive amount of the Glacial debris brought within reach of the streams. But during the earlier retreat of the ice front from its maximum extent, the silting was facilitated by the differential northerly depression, which existed. During a part of this time, also, it was facilitated in the Ohio Valley by the Glacial dam at Cincinnati."

"7th. After some thousands of feet of ice had melted off, relieving the land from a large part of its burden, the re-elevation of the continent began; (and, as probably the most of the sedimentation of the pre-glacial river gorges had been effected during the earlier portion of this period of reccssion), there was then an indefinitely prolonged period of reëxcavation by continuous torrents of comparatively clear water, facilitated in the Ohio Valley by the wearing away of the Cincinnati dam, which increased by so much the gradient of the stream."

"8th. When equilibrium had been established again, the land was at about its present altitude, but was still covered to a considerable depth with ice north of the most prominent moraines. The great size of these moraines is partly due to the vast amount of englacial material held in the lower strata of the ice."

"9th. The deposits of the so-called Champlain epoch near the margin of the glaciated area were considerably earlier in time than those which settled over the Champlain Valley itself, since no deposits could take place there until the ice had retreated from the area; but these deposits are properly classed together as Champlain, since they belong to one epoch of general movement."

"10th. So great a complication of causes was connected with the production of all the phenomena connected with the period, that there

were doubtless many oscillations of the ice front, both during the general advance and the general retreat of the ice sheet. The extent and continuance of these oscillations is to be learned from study of the buried forests and vegetal deposits which lie between the earlier and later sheets of till, and by such instances of erosion as may be clearly proved to be inter-glacial. But there does not seem to be evidence of any oscillations of the front sufficient to break the proper continuity of the period."

The Colorado Formation and its Invertebrate Fauna.[1]—In a study of a collection of fossils from southern Colorado, Mr. T. W. Stanton found it necessary to review, not only the species definitely assigned to the Colorado Formation, but also a number of doubtful ones vaguely referred to the Cretaceous of Utah and New Mexico. The results of his investigations are published as Bull. No. 106 of the U. S. Geol. Surv., an octavo volume of 189 pages, and forty-five plates. In the compilation of the species, the nomenclature and descriptions have been carefully revised in all cases where better collections or additional facts seemed to make it necessary. Thirty-nine species are believed to be new to science. Mr. Stanton gives a comparison of the lists of fossils to show that the invertebrate fauna of the Colorado formation cannot be subdivided into the well defined zones recognized in Europe, but the fauna on the whole may be regarded as the approximate taxonomic equivalent of the Turonian.

New Polyzoans from the Belgian Cretaceous.—Mr. Ed. Bergens is about to publish a descriptive work with plates of the Cretaceous Polyzoans collected near Limbourg, Belgium. In this work the author figures a score of colonies from the Maestricht formation (Fox Hills) of great rarity. Among the known species is an example of *Lichenopora diadema* Gldfs. with an ovarian cell completely developed; an entire colony of *Camerapora;* a colony of *Retecava clathrata* Gldfs. with the base rounded, figured in this rolled state as *Neuropora cretacea* by Von Hagenow.

The other forms are new and many of them are referred to new genera. The author recognizes the genus *Eschara*, although it is composed of heterogenous elements, in order not to augment uselessly the synonomy, for a study of the soft anatomy has not yet allowed a definite classification to be made. (Bull. Soc. Belge de Geol. Pal. et Hydrog. T. VII, 1893).

---

[1] Bulletin United States Geological Survey, No. 106. The Colorado Formation and its Invertebrate Fauna. T. W. Stanton. Washington, 1893.

Geological News.—GENERAL.—In regard to the term gneiss, Professor T. C. Bonney remarks that it covers a group of rocks rather different in character and very different in history. One (a common type) is a gneiss in consequence of an original structure, and remains very nearly in its original condition. Another (also common) owes its structure to pressure acting on a rock which had already solidified and had become crystalline. The Central Oberland and some parts of the Pennines afford examples. A third (rather rare and exceptional) is the result of the metamorphism of materials which were originally clastic. Such has been the origin of some of the banded gneisses in Sark, and more evidentally in a mass of rock near the base of the Allalin glacier where veins of intrusive granite exhibit a banded structure which can only be explained by a movement of the material while still in a plastic condition. (Geol. Mag., March, 1894.)

ARCHEAN.—According to Mr. Robert Bell, many of the long straight valleys in the Archean regions of Canada now occupied by river stretches, by long, narrow lakes, and by inlets of larger lakes are due to the decay and removal of wide greenstone dykes, together with belts of rocks between them. The writer instances the inlets of the northern part of Georgian Bay, Onaping Lake, Long Lake, Sepiwesk Lake with Nelson River, Mattagomi River and Lake Temiscaming. The latter is from one to two miles wide and has a length of 35 miles, but the channel is continued into Deep River. The writer estimates the depth of this excavation to be about 2,600 feet. Mr. Bell presents stratigraphical evidence to show that this valley existed before the date of the Niagara formation, and he believes that most of the valleys which mark the courses of the decayed dykes were formed before the deposition of the Paleozoic strata. (Bull. Geol. Soc. Am., Vol. 5, 1894).

Dr. U. S. Grant concludes, after study in detail of the granitic area near the eastern extension of the Mesabi range in Minnesota, that the rocks of this region are not altered sediment as has been thought heretofore, but that they are truly eruptive in nature and origin. They are sharply separated from the surrounding clastics, and of later date than those. (Ann. Rept. Minn. Geol. Surv. for 1892).

PALEOZOIC.—Among the Silurian Trilobites described by Messrs. R. Etheridge, Jr. and John Mitchell in Proc. L. S. N. S. W. issued March, 1894, are three new species: *Cyphaspis yassensis, C. horani* and

C. rotunda. The first is of interest as being the only Australian Trilobite in which the supposed auditory organs have been observed. These pores in *C. yassensis* are not situated in the facial sutures, but between them and the front rounded border of the glabella.

The Illinois State Museum has just issued a Bull. (No. 3, 1894) containing descriptions of new species of Invertebrates from the Paleozoic rocks of Illinois and adjacent States, described by Messrs. S. A. Miller and Wm. F. Gurley. The fossils comprise 4 species of Echinida, 49 Crinoidea and 4 Crustacea, referred respectively to 2, 29 and 2 genera. Eight page plates of drawings accompany the text, some of which are not as well executed as one would wish.

MESOZOIC.—In a revision of the genus *Cycadeoidea* Buckland, Dr. Lester Ward refers to the collection of six fine cycadean trunks recently found near Hot Springs, South Dakota. All the cycadean remains thus far found in the southern part of the Black Hills occur in the area marked by Professor Newton as Dakota Group. The fact that no cycadean vegetation has yet been found in the extensive collections from the Dakota group of Kansas and Nebraska, led to a careful examination of the series thus classed by Professor Newton, which results in the following conclusion. The Dakota group of Newton is much more extensive than No. 1 of Meek and Hayden, and while the upper portion certainly belongs to the true Dakota, the lower portion very probably extends to near the base of the Cretaceous. The cycadean trunks belong to this lower portion, and may not differ greatly in age from those found in Maryland described by Tyson. (Proceeds. Biol. Soc. Wash., Vol. IX, 1894).

A collection of Cretaceous plants from Vancouver Island yields 50 species of which 27 are new. These are described and figured by Sir Wm. Dawson in Trans. Roy. Soc. Canada, Sect. IV, 1893. In this connection the author points out the value of fossil plants as indicators of climate and time.

CENOZOIC.—A restoration of *Aceratherium fossiger* Cope has been made under the direction of Professor Williston for the Kansas University Museum. The skeleton is a "composite" made up, probably, of nearly as many individuals as there are bones. The different elements were selected from among many hundreds of specimens obtained from a fresh water Pliocene deposit near Long Island, Kansas. The

dimensions of the skeleton are as follows: Length, not including tail, 9 feet; height, 4 feet; greatest girth, 9 feet 4 inches. (Kansas Univ. Quart., April, 1894).

In discussing the mammoth remains in Canada and Alaska, Dr. G. M. Dawson notes that in the northwestern part of the continent they are abundant in, if not confined to the limits of a great unglaciated area there existing. This area comprises nearly the whole of Alaska and part of the adjacent Yukon district of Canada. No *mastodon* bones have been reported from this region. (Quart. Journ. Geol. Soc., Feb., 1894).

A collection of Tertiary Mammals is reported upon by Professor John Eyerman. The most of the specimens were obtained by Dr. Forsyth-Major, *in situ*, in southern France and Italy. The collection comprises 7 Insectivora; 3 Carnivora; 14 Rodentia; and 5 Ungulata. Of the Insectivora, one represents, according to Dr. Major, a new family and genus. Also there is one new genus of Murid rodents, closely related to the American *Paciculus* of Cope. (Am. Geol., Vol. XII, 1893).

Signor G. A. Amicis has just published (Bull. Soc. Geol. Ital., 1893) "I foraminiferi del pliocene inferiore di Trinité-Victor (Nizzardo)," an important contribution to our knowledge of the Pliocene Foraminifera of Italy. One hundred and twenty-six forms are recorded, to each of which a very full and interesting synonymy is given, while only two forms are recorded as new, an evidence of the extreme care bestowed upon his work by the author, who has swept away many varietal forms recently described as new by other authors from imperfect acquaintance with the literature. (Nat. Sci., Feb., 1894.)

In summing up the data concerning the drainage features of the upper Ohio Basin, Messrs. Chamberlain and Leverett agree that the evidence is very strong that the two uppermost sections of the Allegheny basin, (including also Oil Creek Basin) and the middle Allegheny discharged northwesterly; the evidence relative to the lower Allegheny and the upper setion of the Ohio River favors a northerly discharge, but is too incomplete to justify a firm opinion. The authors hold to the belief that no hypothesis of continuity can explain the phenomena of the glacial drift and terraces of the region under discussion. They offer four hypotheses in explanation of the phenomena observed, all of which agree on the most vital points, and all emphasize the importance and significance of the first glacial epoch. (Am. Journ. Sci., Vol. XLVII, 1894).

MINERALOGY AND PETROGRAPY.[1]

Eleolite Rocks from Trans-Pecos Texas.—In a recent report on Trans-Pecos Texas Osann[2] gives a few brief notes on the igneous rocks of the region. The most interesting points in the article, which, on account of the short time allowed the author to prepare it, is little more than a collection of notes, refer to the alteration of limestones by granite and the production of a rock composed almost exclusively of calcium silicates; to the existence of eleolite syenites and phonolites in the Davis Mountains; to the occurrence of a tourmaline schist in the Van Horn Mountains, and of altered diabases and squeezed porphyries in the Carriso Mountains. The eleolite syenite is a fine grained, light colored rock with the typical trachytic structure. It contains orthoclase, eleolite and olivine as phenocrysts and sodalite, aegyrite, malacolite, hornblende, arfvedsonite and the rare minerals ainigmatite, laavenite and pyrrhite in its groundmass. The olivine is nearly colorless in thin section. It usually plays the part of a nucleus around which the other dark components have crystallized. The pyroxene occurs in two generations. The amphiboles are also in two generations, and often these and the pyroxenes are intergrown with their *c* axes and clinopinacoids coinciding. Ainigmatite is common in the rock, laavenite and pyrrhite are rare. The phonolites fall into two types. Those of the first type are characterized by their fine grain, by the abundance of needles and grains of aegyrite in their groundmass, and the absence from them of amphibole and other accessory components. In the rocks of the second type are a few phenocrysts of feldspar and of nepheline, the latter of which are often bordered by a dark corona of bisilicates. The most prominent of these are aegyrite and malacolite among the pyroxenes and among the amphiboles a variety with a strong pleochroism as follows: A=dark greenish blue; B=dark grayish brown; C=light yellowish brown. Cutting the eleolite syenite are dykes of tinguaite, monchiquite, alnoite, ouachitite, and a rock to which the author gives the name paisanite, since it was found in Paisano Pass in the Davis Mountains. This new rock consists of a few phenocrysts of quartz and of sanidine in a dense white matrix spotted with blue hornblende whose optical properties show it to be riebeckite. The white matrix is composed of

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Fourth Ann. Rep. Geol. Survey of Texas, p. 123.

intergrowths of albite and orthoclase cemented by granophyric quartz. It is unfortunate that the author cannot further pursue the studies so auspiciously begun.

The Differentiation of Rock Magmas.—In a recent number of the *Journal of Geology* are two contributions relating to the theory of the differentiation of rock magmas. One, by Iddings,[3] is a simple statement of the nature of the phenomena that have led to the proposal of the theory. The article does not discuss the causes of the differentiation of magmas except in general terms, but it deals with the facts that seem to indicate that such a differentiation of a homogeneous magma into unlike parts is alone capable of accounting for the great differences observed in the various rocks emanating from a single volcanic center, and in different portions of the same rock mass. The second article, by Backtsröm[4], was written to call attention to the difficuly of explaining magmatic differentiation upon Soret's principle, which applies, so far as we know, only to dilute solutions, and effects only the proportions existing between the solvent and the dissolved body in different portions of a solution. The author prefers to consider rock magmas as mixtures of liquids, some of which are less soluble in others at certain temperatures than at certain different temperatures. Hence if a homogeneous magma cools to a temperature when some of its constituents become difficultly soluble in the mixture of the others, it will become separated into parts possessing different compositions—liquation will ensue. Thus basic concretions are sometimes formed in acid rocks, and the acid and the basic lavas of Iceland occur in numerous flows, side by side, while intermediate rocks are absent.

The Old Volcanics of South Mountain, Pennsylvania.—Miss Bascom[5] has examined with great thoroughness the acid volcanics of South Mountain, Pa., whose existence was made known to the geological public a year[6] ago, and has described briefly the results of her study. These volcanics exhibit many of the features of modern rhyolites in spite of the fact that they have undergone profound alteration since their eruption. Fluidal, micropoicilitic, spherulitic, axiolitic and lithophysal structures are noticed in the various speci-

[3] Jour. Geol., Vol. I, p. 833.

[4] Ib., Vol. I, p. 773.

[5] Jour. Geol., Vol. I, p. 813.

[6] Amer. Jour. Sci., XLIV, p. 482.

mens; perlitic parting is occasionally detected in them; amygdaloidal phases are not uncommon, while taxitic and trichytic structures are frequently met with. The original components of many of the South Mountain rocks have entirely disappeared and in their place are now found only quartz, epidote, magnetite and leucoxene. These minerals are evidently secondary and yet in some specimens they are associated in micropoicilitic intergrowths, thus indicating to the author the secondary origin of this structure in the present instance. The spherelites in the rocks under consideration are often imbedded in a base that was formerly a glass, though it is now a holocrystalline quartz-feldspar mosaic, which must necessarily be of the nature of a devitrification substance, since the mosaic is crossed by delicate perlitic partings. The rocks of the region are thus comparable with the lava flows of more recent age. Some of them were obsidian, others were lithoidal rhyolites and others holocrystalline rhyolites. The structure of the obsidians is now microcrystalline in consequence of the alteration or devitrification processes to which they have been subjected. They are now felsites or microgranites, but their microgranitic structure is not original. It is the result of devitrification. The author would therefor not call the rock a microgranite, nor an obsidian, but would designate it as an apobsidian or an aporhyolite, indicating that it was once an obsidian which has become devitrified—the preposition signifying that the rock to which it is prefixed has undergone alteration of a specific nature.

Another Occurrence of Websterite.—Another occurrence of the basic rock websterite is reported by Harker[7] from Fobello, Lombardy, Italy. The rock is a dark aggregate of black diallage moulding smaller grains of hypersthene. In thin section the diallage is colorless. An eclogite from Port Tana, Norway, consists of garnets holding inclusions of cyanite, omphacite and zircon, imbedded in a groundmass composed chiefly of colorless omphacite and quartz, in which lie phenocrysts of idiomorphic enstatite. A garnet amphibolite from Sutherland, England, a quartz diorite from Viti Leon, Figi, and a uralitized gabbro from Ena, Tonga Islands, are also described by the same author.

Petrographical News.—The nickel ores of Sudbury, Ontario, like those of Norway and Sweden, are associated with gabbro and norite, along their contact with other rocks. The ores are supposed by

[7] Geol. Magazine, VIII, 1891, p. 1.

Vogt[8] to be cencentrations from the magma that yielded the gabbro since the olivine of this rock often contains small percentages of nickel and other comparatively rare metals. The principal ore is a nickel marcasite with 3—5.5 per cent. Ni. The same author describes a nickeliferous pyrite from Beiern, Norway, whose density is 4.6, crystallization regular and hardness 4. It is not magnetic.

A peculiar quartz-porphyry consisting of quartz phenocrysts and crystals of apatite and an altered mineral supposed to be enstatite imbedded in a very fine grained weakly doubly refracting groundmass, which is water clear in thin section except where bespattered with dust inclusions or amorphous iron oxide, is mentioned by Hornung[9] as probably forming a sheet among the diabases and clay slates near Stalberg in the Harz.

Since many of the Maryland granites enclose fragments of other rocks that have suffered contact metamorphism, and since their microscopic constituents possess the characteristics of substances that have solidified from fusion, while the rock masses are intrusive in other rocks Keyes[10] believes he is justified in regarding them all as eruptive in origin.

Piedmontite from a new American Locality.—The rhyolites[11] of the South Mountain region in Pennsylvania and Maryland are characterized by their pink or bright red color, which, according to Williams,[12] is due to the large quantity of *piedmontite* in them. This rare manganese epidote occurs as a constituent in the rock mass, as radiating fibres filling veins and as well terminated crystals enclosed in *scheelite* occupying cavities in the rock. The latter were well enough developed to afford material for optical study. The elongation of the crystals is parallel to *b*. Their pleochroism is *A*=yellow; *B*=amethyst; *C*=carmine. Optically they are identical with piedmontite from other localities. An analysis gave (after correcting for quartz):

SiO_2	Al_2O_3	Ce_2O_3	R_2O_3	Fe_2O_3	Mn_2O_3	MnO	CaO	MgO	K_2O	Na_2O	H_2O	CuO	PbO	Total
37.37	22.07	.89	1.52	4.78	8.15	2.28	18.83	.30	.81	.27	2.48	.13	.17	=100.05

a result indicating that the South Mountain mineral is intermediate in composition between allanite, true piedmontite and mangan-epidote.

---

[8] Norges Geol. Undersög., 1892.

[9] Min. u. Petrog. Mitth., XIII, p. 373.

[10] Bull. Geol. Soc. Amer., Vol. IV, p. 299.

[11] AMERICAN NATURALIST, March, 1893, p. 273.

[12] Amer. Jour. Sci., 1893, XLVI, p. 50.

The mineral, when in the groundmass of the rhyolite is often associated with a pale rose epidote (*withamite*) and the common green variety, the latter in some cases surrounding the piedmontite. All of the epidotes are supposed to be of secondary origin.

Some American Minerals.—The interesting mineral *rowlandite* from Llano Co., Texas, to which reference has already been made in these notes, has recently been described by Hidden and Hillebrand[13]. Its color varies from bottle green to a pale drab green shade. It is more vitreous than gadolinite, is transparent in thin splinters and it weathers to a waxy brick red substance. The mineral is isotropic. Its hardness is 6 and its density 4.515. An analysis gave:

SiO_2	X	ThO_2	Ce_2O_3	La_2O_3 etc.	Yt_2O_3 etc.	Fe_2O_3	FeO	MnO	CaO
26.04	.39	.59	5.06	9.34	47.70	.09	4.39	.67	.50

MgO	Alk	H_2O	CO_2	Fl	P_2O_5	Total—O=F
1.62	.28	.24	.34	3.87	tr	= 101.12—1.63 = 99.99.

Disregarding the CO_2 and CaO and reducing the rare earths to a hypothetical one with the molecular weight of the yttrium group the formula becomes $Si_4\,Yt_4\,Fe\,Fl_2O_{14}$ or $Fe\,(YtF)_2\,Yt_2\,(Si_2O_7)_2$.

Transparent *xenotine* in small crystals associated with muscovite in a quartz pocket is reported by Hidden[14] from near Sulphur Spring, Alexander Co., N. C., and a green variety of the same mineral from the Brindletown gold district, Burke Co., in the same State. The green xenotine has been found only in the gold gravels, forming the interior portions of some of the rough brown crystals intermingled with the sand. It is thought to be original substance from which the brown material was derived by weathering. An analysis of the green mineral indicates a complicated composition:

SiO_2	ZrO	UO_2	ThO_2	Al_2O_3	Fe_2O_3	$(La\,Di)_2O_3$	$(Yt\,Er)_2O_3$	CaO	P_2O_5	F	H_2O
3.46	1.95	4.13	tr	.77	.65	.93	56.81	.21	30.31	.06	.57

In a paper entitled "Minerological Notes" Moses[15] describes *pyrite* crystals from a cavity in limestone at King's Bridge, N. Y. The crystals are octahedral in habit, with the octahedral faces striated parallel to ∞ 0∞ and ∞ 02. On the diploid and pyritoid faces the striations are parallel to their intersections, while the cubic faces are unstri-

---

[13] Amer. Jour. Sci., XLVI, 1893, p. 208. Cf. also AMER. NAT., 1893, p. 248.

[14] Ib., XLVI, 1893, p. 254.

[15] Ib., XLV, 1893, p. 488.

ated. The same author[16] has analyzed *ettringite* from the Lucky Cuss Mine, Tombstone, Arizona. The mineral is in aggegrates of radiating fibres resembling in appearance a fibrous pectolite. These fibres are doubly refracting and have apparently a parallel extinction. The analysis of selected material gave:

SiO_2	Al_2O_3	CaO	SO_3	H_2O at 115°	Loss at red heat		Total
1.901	10.157	25.615	17.675	33.109	10.872	=	99.329

Reduced, these figures correspond with the formula

$$2\,[(H_{\frac{14}{5}}\,Ca\,Al_2)\,O_3]_2\,SO_3+8\,H_2O.$$

Pentlandite occurs at the Sudbury Mine in Ontario, intergrown with massive pyrrhotite. Penfield finds[17] its density to be about 5, and its composition: S =33.42; Fe = 30.25; Ni = 34.23; Co = .85; gangue = .67. This corresponds to (Fe Ni) S, in which Fe: Ni = 1:1.32. The three supposed new sulphides *folgerite, blueite* and *whartonite* described by Emmens from this locality are thought by Penfield to be nickeliferous pyrite (blueite and whartonite) or mixtures of pentlandite with some impurity (folgerite).

Hidden reports[18] two new localities for gem *turquoise.* One is in the Cow Springs district of Grant Co., N. M., fifteen miles south of the Azure Mining Company's claim in the Burro Mountains, and the other is 150 miles east of the Burros in the Jarilla Mountains, Doña Ana Co., in the same State. Both localities were formerly worked by the natives. The matrix of the mineral in both cases is a trachyte traversed by fissures filled with quartz, limonite, kaolin, jarosite and other minerals. The kaolin is the result of alteration of the trachyte and the turquoise is regarded as a further alteration product of the kaolin.

A list of the minerals known to occur in Michigan is given by Hubbard.[19] Among these is a talc which the author calls *beaconite.* It occurs in fibres like those of asbestus, with an index of refraction = 1.5–1.6, an optical angle 2V = 60°, and a density of 2.74–2.88 Their composition as found by Packard is:

---

[16] Cf. also Zeits. f. Kryst., XXII, p. 16.

[17] Ib., XLV, 1893, p. 493.

[18] Ib., XLVI, 1893, p. 400.

[19] Rep. State (Mich.) Board of Geol. Survey, Lansing, 1893, p. 171.

SiO_2	Fe_2O_3 . FeO	MnO	MgO	Ign	Total
59.72	8.67	.64	26.42	4.13	= 99.58

corresponding to $H_2 (Mg Fe)_3 (SiO_4)_3$.

A pink vitreous *zoisite* found at the Flat Rock Mine, Mitchell Co., N. C., associated with monazite and allanite, has been analyzed by Eakins.[20] Its composition is:

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	H_2O	Total
38.98	31.02	4.15	.23	23.80	2.03	= 100.21

Specimens of *cacoxenite* from six localities have been examined optically by Luquer[21]. All the crystals show parallel extinction, and a few of the larger ones appear pleochroic in orange and light yellow tints. From a few measurements the approximate axial ratio 1: .75 was calculated.

The *heulandite*[22] from McDowell's quarry, Upper Montclair, N. J., crystallizes in forms agreeing essentially with those of crystals from Baltimore.

The material of the pale green crystals of muscovite from the dolomite of King's Bridge, N. Y., is a mica of the first order. Its apparent axial angle is 2E = 62° 11′, 2E = 60° 37′.

Mineral Syntheses.—The ferrous bye-products of aniline factories at Laar, near Ruhort, Westphalia, when dumped upon the ground to dry, are so rapidly oxidized that the heaps soon become too hot to handle. The material hardens and assumes a metallic lustre.[23] On the walls of cavities within it crystals form whose habit is that of *hematite* but whose composition indicates an admixture of hematite with magnetite.

Upon heating to 1200° in a graphite crucible for several hours, one part of titanic iron and two and a half parts of pyrite, Michel[24] obtained a crystalline mass with the properties of *pyrrhotite*. This is filled with vacuoles on whose walls are implanted tiny crystals of *rutile* with the characteristics of the natural mineral.

Monticellite in well developed acicular crystals is reported by von

---

[20] Amer. Jour. Sci., 1893, XLVI, p. 154.

[21] Ib., 1893, XLVI, p. 154.

[22] A, J. Moses: School of Mines Quart., XIV, p. 326,

[23] Zeits. d. deutsch. geol. Ges., XLV, p. 63.

[24] Bull. Soc. Franc. d. Min., XVI, p. 37.

Gümbel[25] as existing in the slowly cooled silicate slags from the lead furnace at Friehung near Vilseck in Bavaria.

V. Goldschmidt[26] calls attention to the advantage of glass over charcoal in securing sublimates of volatile substances arising during blowpipe analysis. He also gives the description of an apparatus which enables the manipulator to reduce his metallic compounds upon charcoal and collect their sublimates upon ordinary object glasses.

[25] Zeits. f. Kryst., XXII, p. 269.
[26] Zeits. f. Kryst., XXI, p. 329.

ZOOLOGY.

Classification of the Nemertines.—There has been a disinclination on the part of some systematists to adopt the subdivisions—Palaeonemertini, Schizonemertini, Hoplonemertini and Malacobdellini proposed by Hubrecht. Dr. Otto Bürger has returned to the problem, and he proposes[1] the following divisions:

Protonemertini in which the longitudinal nerve cord lies either in the ectoderm or between this and the muscular layer; Mesonemertini in which the cords are in the muscular layer, and Metanemertini in which they are found in the body parenchyma. Bürger further calls attention to "lateral organs" in many species of Carinella. They consist of epithelial discs, sometimes projecting sometimes grooved, richly supplied with nerves, and, although sometimes containing glands, always free from pigment. He halfway expects that some Nemertine will be found in which the whole lateral line is made up of such sense organs.

Ceratodus.—At last we are to have an adequate monograph of this most interesting form. Some years ago the Royal Society of London gave a grant to ascertain its history. An English naturalist was sent to Australia, where he obtained considerable material for an account of this and the Monotremes, but this material has been treated in a regular dog-in-the-manger fashion. Some two or three years ago, aided by funds from the Ritter foundation, Dr. Richard Semon went to Australia with the same object in view, and the results are now beginning to appear.[2] From the first parts we learn that Ceratodus is confined to the middle portions of the Burnett and Mary rivers; that it cannot go upon land, and that it may be caught with a hook baited with almost any animal substance. The native name is given as Djelleh (we had supposed it to be Barramunda). It breathes between 30 and 40 times a minute. The reproductive season lasts from April to the last of November, and is at its height in September and October. The eggs are enveloped in a gelatinous envelope, and their specific gravity is greater than that of water. The segmentation is much like that of Petromyzon and the Amphibia. The development within the egg occupies 10 to 12 days, and the anterior extremities appear 14 days after hatching, the hinder after 2½ months. No fold was observed connecting the anterior

---

[1] Verh. Deutsch. Zoolog. Gesellsch. III Jahresversammlung, 1894, p. 24.

[2] Deuksch. Med. Nat. Ges. Jena. Bd. iv, 1894, also separate.

and posterior limbs. There are no larval gills nor sucking mouth. Young fish are rarely taken, and those under a foot in length, never.

Some Proposed Changes in the Nomenclature of the American Mammalia.—The changes in nomenclature herein proposed are the outcome of a critical study of the literature and synonymy relating to the Mammals of Ord's Zoology, which was published in Philadelphia in 1815, in the second American edition of Guthrie's Geography.

As already announced in THE NATURALIST (March, 1894, p. 289), a reprint of a recently discovered copy of this extinct work will be shortly issued by the subscriber. In an appendix to this reprint the following emendations are fully discussed. For several of these no claim of originality is pretended, as they only reaffirm the decisions of others which have not hitherto met with general acceptance, but which, after a very careful examination, appear to merit the endorsement of scientists. The Code of the American Ornithologists Union has been made the basis of these determinations.

1. Red, or New York Bat, *Atalapha borealis* (Müller), "Der Neujorker," Natursys. Suppl., 1776 (No. 21) p. 21, antedates *Atalapha noveboracensis* Erxl., Syst., Reg. Anim., 1777, p. 155.

2. Hence "*Vespertilio borealis*" Nilsson, Illum. Fig. Scand. Fauna haft, 1838, p. 19, pl. 36, being preoccupied, will have to stand as *Vesperugo nilssoni* Keys. & Blas., Wiegm. Archiv., 1839, p. 315.

3. Hang-lip Bat, *Noctilio labialis* (Turton), Syst. Nat., 1802, p. 25, antedates *Noctilo abliventer* Spix, Sim. et Vesp. Brasil, 1823, p. 58.

4. Nine-banded Armadillo, *Tatusia novemcincta* (Linnæus), Syst. Nat., 1758, p. 51. *Tatusia peba* Desmarest, Mam., 1820, p. 368, is a synonym.

5. Arctic Walrus *Rosmarus rosmarus* (Linnæus), Syst. Nat., 1776, p. 49. *Rosmarus trichechus* Gill, Johns. Univ. Cyclop., III, 1877, 633, is in violation of the Code. *Odobœnus* Linnæus (1735) not binominal, was not legally used by Malmgren (Ofver K. Vet. Akad. Forh., 1863, p. 130) until after *Rosmarus* of Scopoli (Introd. Hist. Nat., 1777, p. 490).

6. West Indian Manatee, *Trichechus manatus* Linnæus, Syst. Nat., 1758, p. 34. *Trichechus* is only applicable to the Manatee. Linnæus' type of the genus was the West Indian species. *Trichechus inunguis* (Natterer) is the eastern South American species, and *Trichechus senegalensis* (Desmarest), the Old World representative.

7. Northern Gray Wolf, *Canis lupus nubilus* Say, Long's Exp. R. Mts., I, 1823, 169.

Mexican Gray Wolf, *Canis lupus mexicanus* (Linnæus), Syst. Nat., 1766, p. 60.

If we consider the American Wolf a distinct species from the European, and the Mexican animal a subspecies, their names should stand *Canis mexicanus* Linnæus (sup cit.) and *Canis mexicanus nubilus* (Say.) (sup cit.). *Canis lupus griseo-albus* (Sabine) J. A. Allen, is inadmissible. *Canis lupus griseus* Sab. is antedated by *C. griseus* Boddaert, Elench. Anim., 1784, p. 97.

8. American Gray Fox, *Urocyon cinereoargenteus* (Müller), Natursys. Suppl., 1776, p. 29. Müller's name, as in the case (sup. cit.) of *Atalapha borealis*, has priority over Erxleben's *Urocyon virginianus*, Syst. Reg. Anim., 1777, p. 567.

9. American Red Fox, *Vulpes pensylvanicus* (Boddaert), Elench. Anim., 1784. p. 97.

As cited by Gray, Cat. Brit. Mus. Carniv., 1869, 205, this name has long priority over *Vulpes fulvus* (Desmarest), Mam., 1820, p. 203.

10. Canada Otter, *Lutra canadensis* (Schreber). The "*Mustela lutra canadensis*" of Schreber, Saugt., III, 1778, pp. 458, 588, pl. cxxvi, *β*, has priority over *Lutra canadensis* (Turton) Syst. Nat., 1802, p. 57, to whom this name has been accredited. "*Lutra hudsonica* Lacepede" is a reference I am unable to find.

11. *Ursus americanus cinnamomum* Aud. & Bach., N. Amer. Quad., III, 1853, p. 125, is a synonym of *Ursus horribilis* Ord, Guth. Geog., 1815, p. 291. Both are based on the "Brown" Grizzlies of Lewis and Clark, from the Missouri Valley. These bears should stand as *Ursus arctos horribilis* (Ord). The Pacific Coast Grizzly (if separable) should be named *Ursus arctos horriaeus* Baird, U. S. Mex. B'dry Sur., 1859, p. 24.

12. American Black Bear, *Ursus americanus* Pallas, Spic. Zool., 1780, pp. 6–24. This form, with its brown and yellow variants, is sufficiently constant to remain specifically separable from *arctos*. *Ursus luteolus* Griffith (vid Merriam, Proc. Biol. Soc. Washn., 1893, p. 147), if not distinct from it, is a well-defined variety of *americanus*. Its affinities with *arctos* are much more remote.

13. American Badger, *Taxidea taxus* (Schreber), Saugt., III, 1778, p. 520, pl. 142, *β*. *Taxus*, in a specific sense, has long been misapplied to the European Badger. Schreber originally gave it to the American species, and his name antedates *Taxidea americana* (Boddaert), Elench. Anim., I, 1784, p. 136. The European Badger will stand as *Meles meles* (Linnæus).

14. "Mexican Shrew, *Sorex mexicanus*" Turton,= Tucan, *Geomys mexicanus* (Turton), Syst. Nat., 1802, p. 72, antedates *Geomys mexicanus* (Lichtenstein), Abhan. K. Akad. Wiss. Berl., 1827, p. 113.

15. Florida Gopher, *Geomys tuza* (Ord), Guth. Geog., 1815, p. 292, has unmistakable right of priority over *Geomys pinetis* Rafinesque, Amer. Mon. Mag., 1817, p. 45.

16. Pennsylvania Meadow-Mouse, *Arvicola pennsylvanica* (Ord), Guth. Geog., 1815; p. 292 (foot-note), undoubtedly refers to same species named *A. riparius* by Ord in 1825. Rafinesque's *Mynomes pratensis*, Amer. Mon. Mag., II, 1817, p. 45, further necessitates retention of Ord's first name.

17. "Small Black Squirrel"(=Black Gray Squirrel), *Sciurus carolinensis pennsylvanicus* (Ord), Guth. Geog., 1815, p. 292.

Ord, in a foot-note, defines the Western Alleghanies of Pennsylvania as the type habitat of this race. As such it represents the *S. leucotis* of Gapper, Zool. Jour., V, 1830, 206, over which Ord's name has priority.

18. Eastern Red Squirrel, *Sciurus hudsonius* (Erxleben), Syst. Reg. Anim., 1777, 414, antedates *S. hudsonius* Pallas, Nov. Sp. Glir., 1778, 376. Credit for this name has been wrongly given to Pallas.

19. Hudson Bay Flying Squirrel, *Sciuropterus volucella sabrinus* (Shaw), Gen. Zool., II, 1801, p. 157. *Sciurus hudsonius* Gmelin, Syst. Nat. I, 1788, 153, can never stand for any *Sciuropterus*, owing to Gmelin's double use of it in the above citation.

20. Columbia Gray Squirrel, *Sciurus griseus* Ord, Guth. Geog., 1815, p. 292 (Mss. marg. note of author); ibid, Jour. de Phys., LXXXVII, 1818, 150, antedates *Sciurus fossor* Peale, Mam. U. S. Expl. Exp., 1848, p. 55. The Californian subspecies will stand *S. griseus nigripes* (Bryant).

21. Red-Breasted Squirrel, *Sciurus rubicatus* Ord (same references as above for *S. griseus*), antedates *Sciurus douglassi* Bachman, Proc. Zool. Soc., 1838, p. 99.

22. Mexican Deer, *Cariacus virginianus mexicanus* (Gmelin), Syst. Nat., 1788, p. 179, is based on the "Teuthlalmacame," Hernandez, Hist. Mex., 1651, pp. 324, 325. The description of the latter does not apply to the Prong-horned Antelope, *Antilocapra americana*, so asserted by Berlandier (Baird, Mam. N. Amer., 1857, p. 666; Alston, Biol. Cent. Amer., 1879, pp, 82, 113). Hernandez's figure of the Teuthlalmacame (p. 324), whether of the Deer or the Antelope (it partly fits both), cannot affect the description, which applies to the Deer, as also Pennant and Gmelin have construed it.

23. Black-faced Wood Brocket, *Cariacus tema* (Rafinesque), Amer. Mon. Mag. I, 1817, 44. Mr. Alston, Biol. Cent. Amer., 1879, p. 118, declares this animal to be the *Cariacus rufinus* Bourc. & Puch., Rev. et Mag. Zool., 1851, p. 561. Reference to the descriptions of Hernandez and Rafinesque confirms this view and seems to justify the retention of Rafinesque's specific name as above.

24. Mountain Sheep, *Ovis cervina* Desmarest, Nouv. Dict. Hist. Nat., 1818, p. 551. *Ovis montana* Cuvier is preoccupied by *Ovis montana* (Goat) Ord. "*Ovis montana* Geoff." is a myth. *Ovis canadensis* Shaw, Nat. Misc. XV, pl. 610, is undated.

25. American Bison, *Bison bison* (Linnæus), Syst. Nat., 1758, p. 72.

26. South American Tapir, *Tapirus terrestris* (Linnæus), Syst. Nat., 1758, p. 74.

—Samuel N. Rhoads.

Zoological News.—Worms.—J. P. Moore describes[3] four new species of Branchiobdella parasitic upon American crayfishes. These differ from all European species in the character of the vasa deferentia.

Louis Joubin has just published a monograph of the Nemertines of France, making an octavo volume of 235 pages, illustrated by four plates.

Rotifers.—H. S. Jennings points out[4] that the genus Plœosoma of Herrick (1885) has, as synonymes, the names Gomphogaster, Gastropus, Gastroschiza, Bipalpus and Dictyoderma. The species which Herrick described as *P. lenticulare* may be the same as *Euchlanis lynceus* Ehrenberg; if not, it is a distinct form. Jennings also states that *P. hudsoni*, of Europe, inhabits Lake St. Clair, as does *Hudsonella picta.*

Mollusca.—P. H. Mason, among other interesting facts states[5] that cases of mimicry and of hybridization are unknown among the shells of molluscs, and that these cannot be invoked as playing any part in the evolution of new forms. He would rather believe that the variations are to explained as depending upon the relations of the animal to the shell and of the whole to its surroundings.

---

[3] Proc. Acad. Nat. Sci., Philadelphia, 1893, 419.

[4] Zool. Anzeiger, xvii, p. 55, 1894.

[5] Jour. Conch., vii, 328.

Hexapoda.—F. W. Goding catalogues[6] with synonyms 278 species of North American Membracida. The new genera are Evashmeadea and Vanduzea.

Joamny Martin has investigated the place of oxygen in insects.[7] A solution containing indigo in a colorless condition, but capable of becoming blue in contact with oxygen, was injected into the body cavity of various larvæ, and subsequent dissection showed that only in the neighborhood of the finest tracheal branches, where the "spiral filament" is lacking, was the solution colored. Consequently it is only in these regions that oxygenation of the blood can occur.

Hemichorda.—In an article "Who First Found Balanoglosus?"[8] the Rev. A. M. Norman says that Cavolini figures it in the Atlas of Delle Chiaje. To this Carus replies[9] that in the text the figure is said to represent the spiral ovary [the urticating tentacles spirally coiled up] of "Rombo amento," according to Delle Chiaje *Stephanomia uvaria.* Norman replies[10] that Cavolini's figure refers to the "ovary of *Agalmopsis cavolinii.*"

[6] Bull. Illinois State Lab. N. Hist., xiv, p. 391.

[7] C. R. Soc. Philomath, Paris, 24 Dec., 1893.

[8] Ann. & Mag. N. H, xiii, 136, 1894.

[9] Zool. Anz., xvii. Liter. p. 10, 1894.

[10] L. c., xiii, p. 216, 1894.

EMBRYOLOGY.[1]

Oökinesis in Limax maximus.—The observations here given are confined to early stages of the egg while in the oviduct, and before the expulsion of either polar globule. The article, therefore, deals with stages which, for the most part, preceed any discussed by Dr. Mark in his excellent treatise on *L. campestris.*[2]

Of the following wood-cuts, Fig. 1 is a diagrammatic representation of the oviduct from a laying animal, from which eggs were taken, and studied serially as numbered. The vitellus averaged 156.2 μ in diameter. Various methods were made use of in fixing—Fols solution: osmic acid, 1 %, followed by Merkel's fluid; chromic acid, ⅓ %, etc., but the one which gave the best satisfaction was as follows: The body cavity of a laying animal was opened by a quick cut of the scissors, and the animal plunged into a boiling hot solution of corrosive sublimate; allowed to remain one minute; transferred to water and eggs removed from oviduct and shelled.[3] Vitellus allowed to remain in distilled water two minutes, then transferred to 35 and 50 % alcohol, remaining three minutes in each grade; then to 70 % alcohol for permanent preservation. I found that if eggs were allowed to remain in distilled water three hours or more, they shelled better, the vitellus coming out clearer and freer. For examination of eggs in toto, Czokor's alum cochineal gave, as a rule, good results. Ten minutes' stay in this dye appeared to give the necessasy differentiation; but for examination of sections much longer time was necessary, two to three hours or more. Picrocarminate of lithium was also found to be excellent, if anything, better than Czokor, on account of its differentiating nucleus structures.

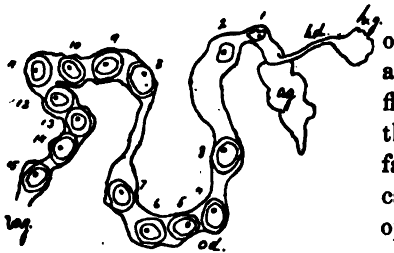


FIG. 1.

---

[1] Edited by E. A. Andrews, Baltimore Md., to whom communications may be addressed.

[2] "The Maturation, Fecundation and Segmentation of *Limax campestris* Binney," by E. L. Mark, Bulletin of the Museum of Comparative Anatomy, Vol. 6, parts 11 and 12, Cambridge, Mass, 1881.

[3] In the upper part of the glandular portion of the oviduct there were a number of eggs in which the outer membrane or shell was barely formed, in some, egg No. 1, for example, there was no membrane at all, and in others only the inner membranous coat was present.

For examination in toto, 24 hours in this stain, and then washing with distilled water and pure alcohol gave good results.

Section staining on slide was also found desirable and Safranin was the stain used—2½ hours, followed by acidulated (½ % Hcl) alcohol of 90 % grade for 7–10 minutes.

The Schällibaum should be new, the sections carefully applied to a well smeared slide, and kept at 60° C. for exactly 15 minutes.

If Mayer's albumen fixative is used, only warm, and as soon as paraffine is melted remove slide from heat.

A number of sections of the hermaphrodite duct (h. d. Fig. 1) were made. One egg was found, in this duct, near the hermaphrodite gland, containing two polar corpuscles, each surrounded with a faintly stained Hof, and each showing striae radiating from corpuscle through Hof. About 8 chromosomes were observed irregularly grouped in the well-defined archoplasm of Boveri.[4]

From these sections it appears that the centres of attraction which Garnault[5] says do not exist in the ovarian egg of *Arion* and *Helix*, and which were not seen in the hermaphrodite gland of *L. maximus*, do exist in the duct very near the gland. They evidently appear immediately after the egg has left the ovary. This duct was lined, for the most part, with ciliated epithelium, and contained much mucus.

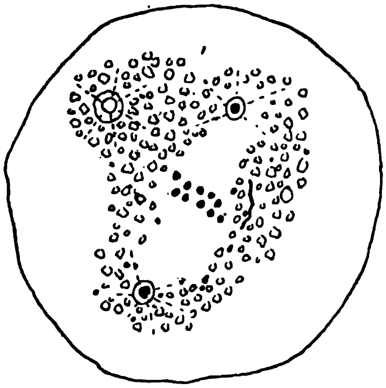


FIG. 2.

Fig. 2 illustrates an optical section of egg No. 1 from glandular part of the oviduct (see Fig. 1) viewed obliquely to the long axis of the spindle, and showing the two polar corpuscles and chromosomes, there being about twenty of the latter lying in an irregular cluster in the clear space between the corpuscles. This egg was stained in picrocarminate of lithium for 30 hours. In its examination a Zeiss Oc 2 and Obj. E were used. A broken membrane, "membrane rougée," was seen with apparently chromatic thickenings in it. Observations on this egg coincide closely with those of Garnault on *Arion* and *Helix*, and, in a measure, with those of Vejdovsky on *Rhynchelmis*.[6]

---

[4] "Zellen-Studen" von Dr. Theodor Boveri, Jena, 1887.

[5] "Sur les phénomènes de la fécundation chez l' Helix aspersa et l' Arion empiricorum."—Zoöl. Anzeiger Nos. 297 and 298, Dec., '88 and Jan., '89.

[6] Die Entwecklungsgeschicete der Oligochaeten (*Rhynchelmis*), 1888.

The larger corpuscle is the one nearest the observer. The structural peculiarity of one side of the nucleus should be noted—where cytoplasm and yolk granules are in intimate relation with contents of nucleus. This is Garnault's "prophase;" it is the stage just previous to formation of nuclear plate leading to the forming of first polar globule. In another egg, No. 9, from the same oviduct, an optical section showed rays of hyalocytoplasm pushing out from clear area through granules of vitellus. Chromosomes irregularly placed in hyaline area. Spindle striae observed in viewing the egg at right angles to spindle axis.

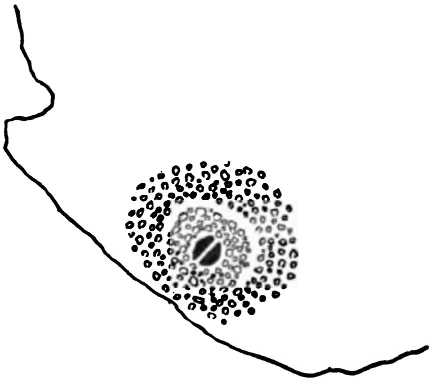


FIG. 3.

Fig. 3 illustrates an optical section of egg No. 11 from oviduct of another animal, occupying the same relative position as No. 11 in the oviduct drawn. In an eccentric position, and near the surface, a clear circular area with radial striae was observed, indicating the presence of the male pronucleus. A portion of the membrane of the germinal vesicle still present. Egg No. 10, in the same animal, also showed circular male area in direction of axis of spindle, and chromatin granules within it. In egg No. 9 the head of spermatozoön was seen in optical section, some little distance from periphery, circular with narrow Hof about it and striae radiating from Hof. Very fine granules were evident within this pronucleus.

Fig. 4 illustrates part of a section of egg shown in Fig. 2, cut in such a plane as to show the sperm nucleus near the periphery. Drawn with Zeiss Oc 1 and $\frac{1}{18}$ oil immersion. Garnault says, in speaking of formation of sperm nucles in *Arion* and *Helix*, "the spermatozoön enters just before first kinesis or immediately after. The contracted head does not begin to change until after the expulsion of the second polar globule. The sperm-head first

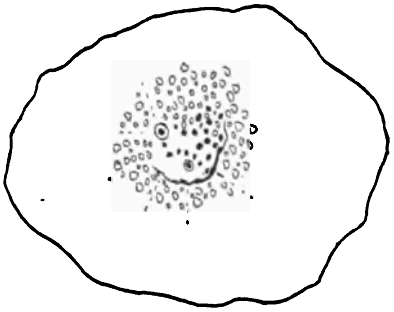


FIG. 4.

divides into two chromatin spherules, then, by successive divisions, there is formed a great number of spherules which remain inclosed in a clear areole. This clear areole recalls the hyaline centre of attraction when that has received the half plate for the formation of a vesicular nucleus.[7]

—F. L. WASHBURN.

---

[7] The following few notes pertaining to the fixing and staining of *freshly laid* eggs may be of interest.

Eggs placed for 5 minutes in Fol 99 (1 % chromic 25 vol. 2 % acetic 50 vol, H_2O 25 vol) then shelled in water, vitellus in same solution for 5 minutes, H_2O 10 min., and 35 % and 50 % alcohol 5 minutes each, 70 % 30 min. and 90 % ad. lib. gave good results, taking picrocarminate of lithium very well if left long enough in stain. They also took borax carmine very well after the above treatment.

Both of these stains did well after the eggs were immersed in chromic $\frac{1}{3}$ % 10 min., then shelled in large quantity of water, then vitellus in chromic $\frac{1}{3}$ % 4 min., and H_2O and grades of alcohol as above.

Whole egg in osmic acid 1 % 5 min., followed by Merkel's fluid 4 hrs.; shell, then water and grades of alcohol 2 min. each to 70 % for permanent preservation were quite satisfactory. It gave good results as to nuclei when eggs were left in picrocarminate of lithium for 48 hrs.

ENTOMOLOGY.[1]

Tertiary Tipulidæ.—Another important contribution to our knowledge of fossil insects has just been made by Mr. S. H. Scudder, whose Tertiary Tipulidæ[2] is in many respects one of the most satisfactory memoirs upon a fossil family that we have. It is remarkable that a large proportion of the several hundred specimens of these delicate insects collected in the famous Florissant deposits have not only "the venation of the wings completely represented, with all their most delicate markings, but also the slender and fragile legs with their clothing of hair and spurs, and to some degree at least the antennæ and palpi. Even the facets of the compound eyes are often preserved as in life." The nine lithograph plates accompanying this paper show very well the correctness of these statements.

Mr. Scudder describes twenty-nine new species belonging to ten genera of Limnobinæ and twenty-two new species belonging to five genera of Tipulinæ. The general results of his study are summarized as follows:

1. The general facies of the Tipulid fauna of our western tertiaries is American, and agrees best with the fauna of about the same latitude in America, as far as we are at present acquainted with it.

2. All the species are extinct, and though the Gosuite Lake and the ancient lacustrine basin of Florissant were but little removed from each other, and the deposits of both are presumably of oligocene-age, not a single instance is known of the occurrence of the same species in the two basins. The Tipulid fauna of the Gosuite Lake, however, is as yet very little known, and it should be added that the few described species are in no instance the same at Green River, Wyo., and White River, Colo., both localities in the same ancient lake basin.

3. No species are identical with any of the few described European tertiary Tipulidæ.

4. Restricting ourselves to the Florissant basin, from the paucity of material in the Gosuite fauna, it will be noticed that a remarkable proportion of genera (eight out of fifteen) are not yet recognized among the living, these genera including about one-third of the species.

---

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Tertiary Tipulidæ, With Special Reference to those of Florissant, Colorado, By Samuel H. Scudder. Proc. Amer. Phil. Society, vol. XXXII. Reprinted April 4, 1894.

5. With one (American) exception—Cladura—all the exisiting genera which are represented in the American tertiaries are genera common to the north temperate zone of Europe and America, and are generally either confined to these regions or the vast proportion of their species are so confined. A similar climate is indicated, but this latter conclusion should be received with hesitation, since our knowledge of the distribution of American genera is mostly confined to the Atlantic States. There are, however, no certain indications of a warmer climate, such as have been shown from the study of other groups.

6. There are no extinct groups higher than genera, but one or two of these, such as Cyttaromyia and Micrapsis, are of a somewhat striking character.

7. The relative importance of the two subfamilies of Tipulidæ though differing on the two continents of Europe and America both in tertiary and in recent times, was much the same, on each continent, in tertiary times as now; while in the relative preponderance of the different tribes of Limnobinæ, our tertiary fauna shows a somewhat closer agreement with the European tertiary than with the existing American fauna. There are, however, no striking generic alliances pointing in the same direction.

Dr. Packard on Lagoa crispata.—In an important paper presented to the American Philosophical Society[3] Dr. A. S. Packard gives an interesting account of a remarkable moth, accompanied by seven plates of figures. The larva in question is remarkable because it possesses the rudiments of two pairs of abdominal legs in addition to the five pairs usually present in lepidopterous larvæ. In summing up the characters which lead him to consider Lagoa a generalized type the author says: In the superficial characters of the imago and in having in the larva abdominal legs, Lagoa resembles the Liparidæ, but in all its essential characters, those of the egg, larva, pupa and imago, it belongs with the Cochliopodidæ, except in the matter of the presence of abdominal legs in the larva. On this account it seens fairly entitled to be regarded as the type of an independent group. We may either regard it as a generalized ancient group of Cochliopodidæ, and refer it to a subfamily Lagoinæ, or we may boldly remove it altogether from either of the two families mentioned and consider the genus as the representative of a distinct family and designate the group by the name

---

[3] A Study of the Transformations and Anatomy of *Lagoa crispata*, a Bombycine Moth. Proc. Am. Phil. Soc., vol. XXXII, pp. 275–292.

of Lagoidæ. This on the whole seems to us to be the most judicious course to pursue. At all events the insect is plainly enough an ancient ancestral or generalized form. It is, so to speak, a primitive Cochliopodid with larval abdominal legs. It lays eggs like those of Limacodes, etc.; its head in the larval state is concealed from above by the prothoracic hood; its larval armature is more of the Cochliopodid type than Liparid; so are the pupal characters and the nature of the cocoon; and the shape of the important parts of the head and the essential features of the venation are overwhelmingly Cochliopodid. Under these circumstances we feel justified in regarding Lagoa as a most interesting ancestral form, and as affording arguments for considering the Bombyces, as a whole, as a generalized and ancestral group, and epitomizing the other higher Lepidopterous families somewhat as Marsupials do the placental orders of mammals."

In a note Dr. Packard announces his recent discovery that Lagoa is preoccupied by Megalopyge of Hübner, and Lagoidæ by Megalopygidæ of Berg.

Miss Ormerod's Report.—Miss Eleanor A. Ormerod's seventeenth report on the injurious insects of England which has lately appeared forms a volume of 152 pages treating of a great variety of insect pests. There are a number of illustrations, several being new. The most remarkable insect appearance of last season was the so-called plague of wasps, already mentioned in the NATURALIST. Concerning this Miss Ormerod writes: "The enormous excess of wasp presence over the average was in many places nothing short of a calamity, inflicting pain, and to some degree danger to ourselves, and to horses exposed to sudden attack, and great loss to fruit-growers. Within our houses in many cases the wasps swarmed to such a degree and especially at meal times as to make their presence on the food a real trouble; the agricultural or garden laborers were severely stung where working on crops to which the wasps had been attracted by the presence of aphides, or on fruit stocks where budding was going forward. Also pain, risk and delay in farm work were caused by fierce onslaughts of wasps from nests turned up in plowing. Great losses were caused by the quantity of fruit entirely ruined up to almost wholesale destruction in the grounds of large fruit growers, and to this must added the losses to shop owners dealing in such commodities as find favor in the eyes of wasps for their own consumption, or thievish abstraction for food of the coming on generation still in maggot condition, to be counted by hundreds, in each of the vast number of nests which were the headquarters of the marauding and troublesome pests."

Miss Ormerod attributes the extraordinary abundance of the wasps to the early and long continued drouth which enabled the insects to get an unusual start.

New York Reports.—The Eighth and Ninth Reports of Dr. J. A. Lintner, State Entomologist of New York, have recently been published. They are good sized volumes giving abundant evidence of the pains-taking preparation so characteristic of their predecessors in the same series. The contents of the eighth report include an introductory summary of the important entomological events of 1891; a discussion of a number of injurious insects; notes on various insects and remedies for them; two entomological addresses, and a bibliography of the publications of the entomologist for 1891, 1875 and 1876. The ninth report is equally full of varied and valuable information, and contains besides a reprint of Dr. Asa Fitch's Catalogue of Homoptera which will be apappreciated by many students.

Notes.—Mr. Alex. A. MacGillivray of Ithaca, New York, continues his papers on North American Thysanura in *The Canadian Entomologist.* He advises the restriction of the name Poduridæ to genera having the saltatory organ, and includes the genera in which it is absent under the Aphoruridæ. A number of new genera and species are described.

An interesting colored plate showing the variations of the larvæ of *Arctia caia* appears in *The Entomologists' Record*, Feb. 15, 1894.

Prof. T. D. A Cockerell publishes in Bulletin 10 of the New Mexico Experiment Station a List of Insects found on Cultivated plants in the Mesilla Valley.

Two new Deltoid moths—*Pseudaglossa forbesii* and *Pallachira hartii*—are described by Prof. G. H. French in a recent Bulletin of the Illinois State Laboratory of Natural History.

In a circular recently issued from the Department of Agriculture Mr. L. O. Howard announces the spread of *Aspidiotus perniciosus* through many eastern states, and gives directions for its destruction.

In Bulletins 35 and 36 of the West Virginia, Experiment Station Mr. A. D. Hopkins continues the publication of his studies of wood boring insects. A large number of fairly good original figures are published.

In Bulletin 51 of the Ohio Experiment Station, Mr. F. M. Webster publishes a number of miscellaneous articles. The one of most general interest is on "Some Insect Immigrants of Ohio."

Professor Herbert Osborn announces the discovery[4] that *Aphis rumicis* is the summer form of *A. euonymi,* and gives observations confirming the statement. He also reports upon the relations of the Schizoneura ovipositing on dogwood (Cornus) and the one living on grass roots.

---

[4] Bull. 23, Iowa Experiment Station.

PSYCHOLOGY.

The Recidivist.—In the September *Forum* there appeared an article on the topic "Criminals not the victim of Heredity." On summing up, the writer comes to the conclusion that "a criminal is like any other man." It is the purpose of the present writer to show, by unimpeachable and incontrovertible evidence, that this last statement is a gross error. The *Forum* writer makes an indiscriminate use of the terms professional, habitual, and congenital criminal. A professional criminal is not, necessarily, a congenital criminal, nor is an habitual criminal necessarily a professional criminal. I presume that the writer of the article quoted above, means the recidivist all through his paper, and therefore will endeavor to prove that the congenital criminal and the recidivist is, anatomically and physiologically, entirely different from normal man in many respects. In this paper I do not wish to enter the domain of speculative psychology, nor do I intend to grapple with the grave problems now agitating sociologists and penologists, therefore will content myself with the introduction of facts and facts alone. The statement of the present writer that the recidivist is, anatomically and physiologically, an abnormal type of man, is not the conclusion of an hour or day, but is the rational deduction obtained from days, months, and years spent at the dissecting table and microscope, and in the study of the criminal, both in a state of freedom and when incarcerated. The criminal physiognomy is of so marked a type that most men are able to recognize it at a glance. I borrowed six photographs of criminals from Major Owen, Chief of Detectives, Louisville, Ky., for the purpose of illustrating an article on "Criminal Anthropology," (which article appeared in the *N. Y. Medical Record*, Jan. 13), selecting them at random from some fifty or sixty other photographs of criminals. Five of these photographs were recidivists, and one was an *occasional* criminal. These six photographs were shown to one hundred men with the following statement and request: "Here are six criminals; five of them are habitual malefactors, and one of them is, comparatively speaking, an honest man—pick out the honest man." Ninety-five men picked out the photograph of the *occasional* criminal without a second's hesitation. The discriminating and exact Maudsley says: "All persons who have made criminals their study, recognize a distinct criminal class of beings, who herd together in our large cities in a thieves quarter, giving themselves up

to intemperance, rioting in debauchery, without regard to marriage ties or the bars of consanguinity, and *propagating* a criminal population of degenerate beings. For it is furthermore a matter of observation that this criminal class constitutes a *degenerate or morbid variety of mankind*, marked by peculiar low physical and mental characteristics. * * * * * * * Their *family likeness* betrays them as fellows by the hand of nature marked, quoted, and signed to do a deed of shame."[1] For obvious reasons, I have taken the liberty of italicizing certain words in the above quotation. A celebrated criminal lawyer of New York once told the writer that he could tell a recidivist at a glance, and that he never made a mistake in his diagnosis of moral obliquity. Professor Enrico Ferri, an Italian anthropologist, tells us that on one occasion he examined several hundred soldiers, and found only one whose face declared him a criminal. He afterwards ascertained that this man had committed murder. Lombroso submitted to thirty-two young girls the photographs of twenty thieves and twenty moral men. Eighty per cent. of these girls recognized the first as malefactors, the second as moral, upright men.[2] Emile Gautier, who was, for a time, confined in Lyons prison says that "these criminals have a general family resemblance, which makes them a class apart."[3] A warden of an eastern penetentiary (Sing-Sing) told the writer that there were not only twins in every prison, but there were "twins, triplets, quadruplets, ay! even twelvelets" (sic). An interesting point in connection with the criminal physiognomy is that it is to a large extent independent of nationality. The German criminal is not unlike the Italian, nor is the French unlike the English criminal. M. Joly remarks, 'I should say that in M. A. Bertillon's' office I was shown nearly sixty photographs of Irish, English, and American thieves. It would have been difficult in many cases to discern the Anglo-Saxon rather than any other physiognomy.[4]

Now let us analyze the criminal type, feature by feature, and see what constitutes this universal and well-marked physiognomy. The observations of the writer when in pursuit of this analysis, were not confined to any particular class of criminals; he examined all classes. He soon discovered, however, that this distinctive type was to be found in the congenital recidivist alone. The occasional criminal and the criminal by calculation (the true professional criminal), were found to

[1] Maudsley. Responsibility in Mental Disease, p. 29.

[2] Lombroso: L'Uomo Delinquente.

[3] Havelock Ellis: The Criminal.

[4] Havelock Ellis: The Criminal, p. 82

be anatomically and physiologically normal. In the recidivist there is marked exaggeration of the cephalic indices. In a dolichocephalic recidivist the long head is very noticeable. The same exaggeration is found in brachycephalic recidivists. Oxycephalism (sugar-loaf head) is very frequently observed. In three hundred drawings taken from live and dead subjects by the writer, one hundred and ninety-eight are oxycephalic. Lauvergne says of this kind of head: "When it is complete, that is to say, when it presents a prominent base supporting an inclined pyramid, more or less truncated, this head announces the monstrous alliance of the most eminent faculty of man, genius, with the most pronounced impulses to rape, murder, and theft." The bilateral elevation of the sagittal suture (Benedikt's lines[5]) has been noticed in the three of the six hundred, who form the class from which these deductions are drawn. Professor Benedikt considers these sutural elevations of great importance in criminal anthropology and in his book *Kraniometrie und Kephalometrie* says "that, though rare, when present they are significant of great moral obliquity." There is, generally, marked enlargement in the orbital arches of recidivists, together with receding foreheads. In three hundred and fifty of the four hundred profile and quarter-face photographs of habitual criminals that I have examined, this enlargement of the orbital arches was plainly noticeable. In the two hundred drawings and photographs that form my collection, it is noticeable in one hundred and eighty-two. Tenchini and Lombroso, as well as Benedikt, have pointed out this abnormality in the orbital arches of criminals. In my collection of skulls there are four skulls of recidivists; all of these show this enlargement of the orbital arches. Prognathism is a marked characteristic in the physiognomy of the recidivist. The large, heavy lower jaw and protruding mouth strikes the observer at once. This feature is rarely absent in the congenital criminal. It is an abnormality eloquent in its atavistic suggestiveness.

The low receding forehead, the enlarged orbital arches, the prognathous jaws, and high cheek-bones of the congenital criminal are strikingly like those of our pithecoid ancestors.[6]

Just here it is proper to state, that, in an article on Effemination and Viraginity which appeared in the *N. Y. Medical Record*, September 16th, I have asserted that atavism only attacks individuals of a neurasthenic type; that the phenomenon of reversion is found only in psychopathic aberrants. This, in a measure, is true in all cases of

---

[5] Benedikt: Kraniometrie u. Kephalometrie.

[6] The writer: Criminal Anthropology, N. Y. Med. Record, Jan. 13.

reversion, but, in the article alluded to, I then had reference to psychosexual atavism alone. Sexual perversion and psychic hermaphroditism are prominent characteristics of the congenital criminal; I do not intend, however, to discuss them in this paper. I have examined, macroscopically and microscopically, twenty-three criminal brains. Twenty of these brains were those of recidivists, and abnormalities were found in all of them. In one of them, taken from a criminal executed for an attempt at rape and murder, there was confluency of the fissures. In several of them the frontal lobe presented four (apparent) convolutions; in all of them there was deficiency in weight. In others the gray matter was scanty and thin, and the convolutions superficical and few in number. Havelock Ellis says: "The important matter of the vascular supply of the brain in criminals has yet received little attention, but a variety of pathological features have been found in the cerebral substance and membrance—pigmentation, degenerating capillaries, etc."; he then adds in conclusion, "It must be added, as a point of considerable importance, that in very few cases have these pathological lesions *produced any traceable symptoms during life.*"[7] There are two kinds of abnormal ears found in the criminal type; large out-standing ears, like those of the chimpanzee and nshiego-mbouve, and ears, small, and closely applied to the skull, like those of the gorilla. I have found that the small ear is generally possessed by the sneak-thief and pick-pocket, while the large ear is possessed by the burglar with murderous tendencies. In all my experience I have never seen an habitual petty thief with a large ear, while all the murderers whom I have examined had large ears. A prison-keeper said to be on one occasion: "I can tell a thief from a murderer every time, by the size and shape of his ears." (sic). I have thirty-six sketches of pick-pockets. These drawings were made from life, and are drawn to scale, and in all of them the ear is small and, generally, misshapen. One sketch, made of a convict now in an Indiana prison, shows the strange abnormality of a forked helix. Féré and Segelas present a cut of an ear somewhat like the sketch just mentioned. There are other abnormalities in the ear of the recidivist, such as "a development of the Darwinian tubercle, absence of one of the branches of the fork, absence of the helix, effacement of the antihelix, etc., etc."[8] Most of these abnormalities are, unquestionably, atavistic attempts, and especially is this true of the small gorilla-like ear and the large, projecting chimpanzee-like ear.

[7] Havelock Ellis: The Criminal, p. 63.

[8] Ibid, p. 68.

The criminal has a peculiar, feral stare, which once seen and noted can never be forgotten. A noted detective, (Bligh of Louisville, now dead) called it the "ape-eye."[9] "Look," said he to me on one occasion when we were discussing criminals, "Look at the next ape you see and you will know what I mean." (sic). The congenital criminal,[10] when looking at one seems to focus his sight on a point some distance beyond one's body. It is difficult to describe this look. Bligh's "ape-eye" comes nearer to it than anything else I can think of.

The special senses are generally very much exaggerated in the congenital criminal. The hearing of twenty-eight recidivists out of thirty tested with the watch, was found to be more acute than normal. Some of these criminals possessed the microscopic eyesight of birds, describing the appearance of minute objects correctly, the details of which, to be seen by me, rendered the use of a lens absolutely necessary; and I may add that my eyes are normal.

Others were far-sighted, some of them being able to read Snellen's type at double the normal distance. The sense of smell, that is for some odors, was decidedly more acute than normal. I washed my hands in water scented with a few drops of violet perfume; they were then washed in pure water and carefully dried. Three billiard balls were then held in the hands for a few moments and then deposited on a table with a half dozen others. Thirteen out of the twenty-eight recidivists under observation, picked out the balls which had been handled declaring that they could plainly distinguish the violet odor. * * * * * I once knew a recidivist in St. Louis who could tell his friends by their personal odors.[11] I had this man's skull in my cabinet for a number of years; it was eventually stolen from me, and is now, probably, in some museum of anatomy. It was strikingly like the skull of the Man of Spy,[12] and an extraordinary instance of atavism in every structural characteristic. I have now analyzed the physiognomy of the congenital criminal feature by feature. When I place each part in its proper place I construct a mosaic of a variety in the human race entirely different from normal man. I have shown

---

[9] The writer: Criminal Anthropology, N. Y. Medical Record, Jan. 13.

[10] I wish to call attention to the fact that I consider the congenital criminal to be the only true recidivist. I make this distinction in order to emphasize the great difference that exists between the professional, occasional criminal, and the true recidivist who is born a criminal. J. W., Jr.

[11] The reader is respectfully referred to the works of Spencer, Tylor, Reclus, Wolfe and others for kindred observations on the special senses of savages.

[12] Wright: Man in the Glacial Period, p. 277.

that these abnormalities are anatomically and physiologically irregular. The brain, the seat of the moral function is involved as well as bone, nerve and tissue. I have said nothing of color (pallor) of the hair, of cutaneous insensibility, of the form and shape of the extremities, and of numerous other abnormalities. I think that I have proven that the recidivist is *not* "like every other man." I promised in the beginning of this paper that I would not enter the domain of metaphysics. I have, in another article, fully discussed this branch of the subject. I cannot refrain, however, from noticing several of the *Forum* writer's statements. His whole paper is made up of assertions, the basis of which are founded on personal beliefs. It is the old story of religion against science; the old mistake of separating mind and brain matter, when, in a measure, the two are identical. I am not an Averroist, nor am I a believer in the doctrines of emanation and absorption. But I do believe, (and this belief can be proven to be correct), that wherever there are receptive ganglia, whether in organisms high or low in the scale of animal life, there this element of the brain, which the Greeks called Psyche, enters in. The *Forum* writer says that he does not believe that the moral function is an inherited one. Does he believe that man sprang into existence fully endowed with all the mental attributes we find in him at the present time? Does he deny the fact that mind has undergone evolution and development since the time of our pithecoid ancestors? Does he mean to maintain that the brain of an infant born to-day is no further developed than was that of one born twenty thousand years ago? Would he have us believe that the moral function is no further developed in us than it was in the ancient Britons, or than it is in the autocthon of Australia? That morals are, to a certain extent, dependent on education, I do not for one instant deny, but that they are wholly so, no one, who knows the negro and the results of a hundred years of moral education expended on him, will for one instant affirm. I take the American negro simply because he is a convenient example. Morals are the result of evolutionary development, of inherited experiences, as much so as any other inherited function. The laws of atavism, of reversion to ancestral types, and of inheritance apply to the mind as well as the body. We cannot place morals, a purely mental function, on a pedestal by themselves and write beneath them "Cave! Deus Sum." Says the *Forum* writer: "The moment that he understands that 'honesty is the best policy' the average professional criminal becomes honest." As I have said before, in the first part of this paper, the *Forum* writer does not discriminate when speaking of criminals. Now this state-

ment may be true in the case of the professional criminal i. e. the criminal by calculation, but it is not true in the case of the recidivist. The recidivist never recognizes the fact that honesty is the best policy, but continues to commit anti-social acts until the end of his life. His moral imbecility, the direct result of atavistic degeneration, is such that he does not consider his anti-social acts criminal in any sense of the word. Dugdale in his remarkable work "The Jukes" has clearly proven how great a factor heredity is in the production of criminals. The evidence in his book alone ought to be convincing to any unbiased mind, but when it is substantiated by the evidence of such men as Lombroso, Ottolenghi, Ellis, Marro and Segelas it becomes absolute authority.

JAS. WIER, JR., M. D.

MICROSCOPY.[1]

Marine Planarians.—In a paper now in press (Journ. Morph., Vol. IX, No. 2), Dr. Wheeler gives a few notes on methods he employed in the study of *Planocera inquilina*, a Polyclad found in the branchial chamber of Sycotypus.

The Bioudi-Ehrlich stain proved to be very useful in making the rhabdites conspicuous.

Owing to the lack of pigment, the nervous system may be traced without difficulty, especially in young specimens. It agrees closely with Lang's description and figures of the nervous system of *Planocera Graffii*. Remarkably clear pictures of the beautiful plexus and its connection with the brain may be obtained by killing in hot corrosive sublimate, staining for 12 hours in Czokor's alum cochineal, and, after dehydrating, mounting in gum sandarac dissolved in absolute alcohol.

In a second paper, l. c., p. 178, devoted to a Triclad (*Syncœlidium pellucidum*) found in the gill-books of *Limulus*, the method of studying the nervous system is described thus:

The great transparency of *Syncœlidium* makes it a very favorable object for the study of the nervous system. The brain and main nerve trunks may be readily seen in the living animal, but this method is insufficient for a study of details. It is, however, only necessary to stain with alum cochineal, extract as much of the stain as possible with water, dehydrate and mount directly from absolute alcohol in gum sandarac to obtain a diagrammatically clear picture of all but the very finest details of the nervous system. The nerves stand out as white lines on a darker background.

Breeding Habits of the Three Triclads of Limulus.—*B. candida*, *B. propinqua* and *S. pellucidum* all deposit their egg-capsules on the gill-lamellæ of their host, *Limulus*. The first species seems to show no preference for a particular region of the gill-leaf, but scatters its egg-capsules over the whole surface. *B. propinqua* selects the basal, or proximal region of the leaf, while *Syncœlidium* prefers a small area near the edge and just lateral to a small marginal callosity which forms a brown line with the callosities of the adjacent leaves when the gill-book is closed.

The egg-capsule of *Syncœlidium* is about .75 mm. long, of an oblong shape and somewhat compressed. It is attached by a slender pedicel, .5 mm. in length, in such a way that one of the flattened sides of the capsule is applied to the surface of the gill-leaf. Usually the capsules

---

[1] Ed. by C. O. Whitman, Univ. of Chicago.

are arranged with their long axes parallel to one another in a little cluster near the marginal callosity. The chitinous wall of the capsule is thin and transparent, but grows thicker towards the poles. Through it the two opaque white eggs or larvæ may be distinctly seen. I have never found more than two eggs in a capsule.

Many of the capsules bear at their outer ends one or more of the deep blue thecæ of an infusorium. These were regarded by Gissler as pneumatic tubes, but Ryder showed that they were the thecæ of "Protozoa of the genus *Epistylis* or *Zoothamnion*."

Both Ryder and Gissler figure the egg-capsules of *Syncœlidium* After describing the capsules of *Bdelloura*, Ryder says: "The second form, represented in Figs. 5–7, enlarged 16 times, is much smaller, but similar in structural features to the preceding. The capsules measure about $\frac{1}{25}$ of an inch in length and contain usually 2 eggs or embryos. At first the ova occupy each one of the ends of the capsule, as shown in Fig. 5; but after the young worms have developed somewhat, they usually lie alongside of each other lengthwise of the capsule. They frequently change positions, however, at this stage and it sometimes happens that there is but one embryo in a capsule."

Gissler's Fig. 2^b is evidently the capsule of *Syncœlidium*, as shown by its size relatively to the infusorial thecæ attached to its summit.

For a description of the egg-capsule of *B. candida* I would refer the reader to the papers of Leidy ('51), v. Graff ('79), Ryder ('82a) and Gissler ('82).

What I take to be the egg-capsule of *B. propinqua*, is considerably smaller than that of the allied *B. candida*, measuring only 1.25 mm. It appears to contain only one ovum, instead of 2–7 as in *B. candida*, but on this point I cannot be positive. I am unable to identify this form of capsule with any of those described by Ryder ('82a).

The three *Limulus*-infesting Triclads differ also in their time of breeding. *B. candida* oviposits during May and early June, when the *Limuli* return from the deep water to the sandy beaches to breed. The passage of the Triclads from one crab to another must be favored by the prolonged coitus of the latter. *Syncœlidium* oviposits in the latter part of July and the early part of August, when the gills are deserted by the half-grown young of *B. candida* for the basal joints of the cephalothoracic appendages. As the *Limuli* have laid their eggs and begin to return to deep water by the first days of July, it is necessary, in order to study *Syncœlidium* and its habits, to collect a number of the crabs early in the season and to confine them in a large fish-box or similar receptacle. *B. propinqua* appears to breed at the same time as *Syncœlidium.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences.—Biological Section.—April 9. H. F. Osborn, in "A division of the Eutherian Mammals into the Mesoplocentalia and Cenoplacentalia", noted that the radiation of the mesozoic placentals into carnivorous, herbivorous and insectivorous types, was analogous to that of recent placentals, or to that of Australian marsupials; Mesoplacentalia would represent a group primitive, as in foot and brain, of great evolutional inertia; it would include Amblypoda and Condylarthra as ungulate types, the Creodonta, Tillodonta and Insectivora as Unginculates and the Lemuroidea as primates.

O. S. Strong, exhibited "Nerve-cell Structures as demonstrated by Golgimethods", and presented for publication a memoir on the "Origin and Peripheral Distribution of the Cranial nerves of Amphibians."

P. Gibier, "A note on Glycosuria produced Experimentally."

A. B. Matthews, "On the Structure and Physiology of the Pancreas Cell." Bashford Dean, *Recording Secretary.*

Proceedings of the Natural Science Association of Staten Island.—April 14th, 1894 Mr. Chas. W. Leng exhibited living and mounted specimens of beetles, new to or rare on the Island, with the following memoranda:

BRYAXIS ABDOMINALIS (AUBE).

Three years ago I found a number of small beetles clinging to the underside of pieces of bark and wood lying on the banks of a salt meadow creek near Arlington; the beetles were first observed by me at the point where the railroad embankment ends and the trestle begins, but Mr. Davis had previously found the same or a closely allied species at other points on the border of the salt meadow. These beetles proved to be *Bryaxis abdominalis*, one of the Pselaphidæ, an addition to the fauna of Staten Island, and, in view of the numbers in which they were found and the rarity of the species of this family as a rule, an addition of unusual interest.

During the early spring of 1893 and again this year I have made some careful observations to determine the date of appearance and the exact localities frequently by those beetles. They may be found early

in February and as late as May, but disappear entirely in the summer months. During this brief period the eggs that are to produce the succeeding generation are laid and their life work being ended the beetles die.

To determine the localities I examined the border of the salt meadow at various points, usually accompanied by Mr. Davis. South of Oakwood a narrow peninsula of upland juts out into the meadow and there, on March 18th, the beetles were plentiful; the slight rise of ground was littered with boards, logs and fragments of bark, carried far inland by unusual tides, and almost every piece sheltered a *Bryaxis*. They did not extend more than ten feet from the meadow and they avoided those boards which were within a few feet of the meadow and constantly damp. On March 25th we searched the border of the meadow west of Richmond. The tides reach these meadows only by way of the Fresh Kills and the wreckage is sparse, perhaps becoming stranded before it reached so far inland. No *Bryaxis* were found. On April 1st I visited the strip of sandy upland that stretches into the meadow south of the water company's wells at New Springville. The conditions existing near Oakwood are here repeated and *Bryaxis* was found in some numbers. On the same day I crossed the turnpike and visited the meadows east of Chelsea, but there is an absence of any sharp dividing line between meadow and upland at that point; no suitable shelter is formed and no *Bryaxis* were found. On April 8th Mr. Davis, Mr. Walter Granger and I examined the meadows at Watchogue very thoroughly but found no large number of beetles. The day was, however, unfavorable and may have affected the result. During this period Mr. Davis twice visited the original locality at the trestle and found the beetles in numbers. This locality is particularly favorable; the operations of the railroad company have caused a quantity of soil to be thrown up in hillocks and ridges which afford the necessary retreat from high water and at the same time a lodging place for the chips and bark that shelter the beetles.

As the result of these observations, repeated in different years and at widely separated localities, I think I am justified in stating that *Bryaxis abdominalis* is abundant from February to May at the border of the salt meadow all around Staten Island; living not on the meadow or near enough to feel the influence of its dampness, but under wood or bark cast by the tide upon the upland.

These beetles are quite small and Mr. Craig kindly prepared a specimen for exhibition under the microscope.

The form of the antennæ, the single tarsal claw and the sculptured abdomen of the male are the characters specially noteworthy.

The family to which this beetle belongs comprises a goodly number of minute beetles, found either beneath stones or wood or in ants' nests. Their habits are but little known; they live on animal substances and their powerful mandibles and long palpal members seem to indicate that they capture fleet and hard shelled prey; some live in pairs while others are gregarious; those living in ants' nests appear to be true inquilines; the ants which support them, by caressing the tufts of hair about the abdomen, cause the exudation of a fluid which they greedily swallow. The larvæ are unknown.

An excellent monograph, by Brendel and Wickham, may be found in the Bull. Laborat. Nat. Hist., State Univ., Iowa, Vol. 1 and 2.

It may be noted that two other minute beetles are always found with this *Bryaxis*, viz: *Scydmœnus salinator*, Lec. and *Rhypobius marinus*, Lec. They are not confined to such narrow limits as the *Bryaxis* but invariably occur where it occurs.

Mr. Leng also contributed the following: *Notes on Naias Flexilis.*

The water plant, *Naias flexilis* (Willd.), Rost. and Schmidt, reported by Mr. Davis at our last meeting, occurs also at Springville and at Bull's Head.

At Springville sparingly, in a small pool on the edge of the meadow, south of Union avenue in the second large field west of the Morning Star road.

At Bull's Head abundantly, in a ditch running south from Lambert's Lane and about a quarter of a mile west of the Morning Star road.

Mr. Arthur Hollick presented a set of three barred owl's (*Syrnium nebulosum*) eggs and read the following memorandum:

In our Proceedings for April 11th, 1891, may be found a short note in regard to a barred owl's nest having been found by Mr. Chas. Rufus Harte, in the vicinity of Bull's Head, on March 27th of that year. On March 12th, 1892, it was again visited by Mr. Harte, as noted in the Proceedings for April 9th, 1892. On each occasion he obtained a set of three eggs from the nest. So far as I am aware the owls were not disturbed in 1893.

I had obtained a rough diagram of the vicinity, sketched by Mr. Harte, and on March 11th, of this year, I undertook to search for the nest. With comparatively little trouble I located the tree, which is situated in the patch of woodland between Bull's Head and Willow Brook. The cavity in which the nest is located faces northwest and is about thirty feet from the ground. The tree is about five feet in

diameter, and destitute of branches below the cavity, so that I found it impossible to climb up. On March 17th I obtained a pair of climbing irons, and with these readily ascended to the nest, which I found to contain the usual number of three eggs, slightly incubated.

The tree is not one which would be likely to attract attention, as it is a vigorous living red oak (not a sweet gum as originally stated), and the cavity is not conspicuous. The female bird was readily alarmed—a slight tap on the tree being sufficient to cause her to leave the nest and to retire to some distance. I did not see the male bird at any time.

In this patch of woods gray squirrels are yet comparatively abundant and one or more pairs of red shouldered hawks nest there every year, besides many crows, but it is doubtful if they can remain undisturbed much longer, as the timber is large and valuable and in several sections the finest trees have been thinned out quite recently.

Mr. Wm. T. Davis exhibited a living pupa and mud cone of the seventeen year locust, with the following memorandum:

The pupæ of the seventeen year *Cicada* have made their appearance. While searching for *Bryaxis*, with Messrs. Leng and Granger, on April 8th, I found several under boards on the edge of the meadow at Old Place creek, one of which I am able to exhibit alive. The ground being damp the pupæ had erected their usual towers of earth, the boards not lying sufficiently close to the uneven ground to prevent their construction.

In the Proceedings for February 10th, 1894, the *Cicadas* that appeared in 1881 should have been referred to Brood XVII instead of XVIII.

Boston Society of Natural History, April 18.—The following papers were read. Mr. Herbert Lyon Jones: Adaptations of fruits and seeds for the purpose of distribution. Dr. Benjamin Lincoln Robinson: Observations upon tropical climbers. Samuel Henshaw, *Secretary*.

SCIENTIFIC NEWS.

The University of Illinois is to open a permanent station on the Illinois River for the biological study of the flora and fauna of the waters of the state. Havana has been selected as the location and suitable laboratory quarters have been obtained. Work will be begun in April and the station will be kept open throughout the year. The Illinois State Laboratory of Natural History and the State Fish Commission will co-operate and the whole will be under the direction of Professor S. A. Forbes. Professor Forbes has selected in the vicinity of Havana a set of typical situations which will be explored throughout the year and probably for several years in succession. The main object is the thorough investigation of the entire system of the plant and animal life of the waters of that region with principal reference to problems of œcology; above all to the effect of the periodical overflow and recession of the waters upon the variety, abundance and interaction generally of the various groups of plants and animals represented in those waters.

Some students may have the Leitz's Mechanical Stage. The following directions copied from the American Edition of Leitz's catalogue of Microscopes and Accessories published by Richards & Co. of New York *may* enable them to apply the apparatus to their stands. "The screw on the right must be lost so, that the lever, of the form of an arc of a bow, can turn around the axis at which it is fixed on the left. Afterward, the stage is to be put on the stage of the mieroscope so, that both angle pieces, opposite to the lever, drives the column of the stand; after putting the lever to its place, the screw gets fastened again. At last, the stage, must be fixed to the column, by drawing close the other screw, being in the middle part of the lever."

Dr. Edmund Beecher Wilson has been elected Professor of Zoology in Columbia College. He was previously adjunct professor of biology.

Dr. L. Will, well-known for his studies in Hexapod morphology, has been called to the chair of Zoology in the University of Rostock.

Dr. F. Ulrich, Professor of Mineralogy and Geology in the technical school at Hannover, died Jan. 25, 1894.

Dr. C. V. Riley has tendered his resignation as U. S. Entomologist, to take effect June 1, 1894. After that date his address will be U. S. National Museum, Washington, D. C.

Dr. Alexander Theodor von Middendorff, possibly best known for his Siberian expedition, died at Hellmorm, Livonia January 28, 1894 aged 79 years.

Dr. Credner, who had been announced as the successor of Prof. H B. Geinitz in the chair of Geology in the Dresden Technical school, will remain in Leipzig. The place will be filled by Prof. E. Kalkowsky of Jena.

The botanist O. L. Sillén of Gefle, Sweden, is dead.

Dr. Leopold von Schrenck, well-known for his explorations of the Amur basin, died in St. Petersburg, Jan. 20, 1894.

Dr. G. Linck, formerly docent, has been made Professor of Geology and Mineralogy in the University of Strassburg.

Dr. George Gordon, well-known to older naturalists. died in Edinborough, Dec. 12, 1893, aged 92 years.

Prof. Edward Zacharias of Strassburg has been called to Hamburg as director of the Botanical Gardens.

Dr. A. Knop., Professor of Mineralogy In the technical school at Karlsruhe, died Dec. 27, 1893. Dr. R. Brauns of Marburg has been appointed extraordinarius in his place.

Richard Spruce, the student of South American Mosses, died at Malton, England, Dec. 30, 1893.

Dr. W. Migula has been called as Professor of Botany and Bacteriology to the technical school of Carlsruhe.

The trustees of the " Elizabeth Thompson Science Fund " have issued their circular for 1894 announcing that the income from the fund, now amounting to $26,000 will be available for distribution in June next. Already nearly $9000 have been distributed in past years to 46 applicants, and in 22 cases the results of work advanced by the fund have been published. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance." The Secretary

of the trustees is Dr. C. S. Minot, Harvard Medical School, Boston, Mass.

Dr. Carl Grobben has been raised to the ordinary professorship of Zoology in the University of Vienna.

Dr. George Bennett, an Australian explorer and Naturalist, died at Sydney in October, 1893, aged 90 years.

Mr. August Carl Eduard Baldamus, the ornithologist, died in Wolfenbüttel, Oct. 31, 1893, aged 82.

Juan Vilanova y Piera, Professor of Geology in Madrid, died in the beginning of November.

C. von Gumpenberg, a student of the Lepidoptera, died in Bamburg, Germany, Nov. 5, 1893.

A. Halfar, Geologist of the Prussian Geological Survey, died in Berlin, Nov. 21, 1893.

Prof. Joseph Boehm, the well-known plant-physiologist, died in Vienna, December 2, 1893.

Dr. Tomquist has been made private docent in Geology and Palæontology in the University of Vienna.

Professor Arcangeli Scacchi, the student of Vesuvius, died in Napha, Oct. 11, 1893.

Dr. J. M. Undset, the investigator of prehistoric Scandinavia, died in Christiania, Dec. 3, 1893, aged 40 years.

George Primics, geologist, died in Belénges, Hungary, Nov., 1893.

H. J. Rink, whose work on Greenland is the handbook upon all Arctic questions, died in Christiania, Dec. 15, 1893.

Dr. Luigi Luciani has been called to the chair of Physiology at the University of Rome as successor to Moleschott.

Prof. W. Krause of Göttingen has been given charge of the collections of the I. Anatomical Institute at Berlin.

Prof. R. Altmann of Leipzig, has been called to the chair of Anatomy in Halle.

Dr. A. Heider, the Bacterologist, died in Vienna, Dec. 26, 1893.

Professor August Wrzesniowski, well-known for his Protozoan studies, died in Warsaw, December last.

The Wollaston medal of the Geological Society of London, has been given to Prof. K. A. Zittel, the Palæontologist of Munich.

The Proposed Division of the National Academy of Sciences.—The following letter explains itself. To the Committee appointed by the U. S. National Academy of Sciences, April, 1892, "to report such proposed modifications of the Constitution and By-Laws of the Academy as are likely in their judgment to increase its efficiency" etc., of which Prof. T. C. Mendenhall is chairman;

Gentlemen: I take the liberty of making some suggestions with reference to the classification of the Academy into divisions, which will in the writer's estimation "increase its efficiency" etc. This increase of efficiency is, in the writer's view, chiefly to be accomplished at present, by electing to membership persons competent in their professions, in such proportionate numbers as to represent properly those professions, as at present cultivated in the United States. At present the disproportion of membership in favor of some departments, and to the prejudice of other departments is great, as the following figures show. Of members which represent the physical sciences, we have now, according to the figures presented at the late meeting, (April, 1894), by your committee, 58; while but 31 represent the Natural Sciences. If the members which represent the proposed section F be added to the division of Natural Sciences, (which they should not be in a correct classification) the latter will include 39 members as compared with 58.

The Academy adopted, at its late meeting of April, 1894, two classes, I and II, those of the Physical and Natural Sciences. The former includes the proposed sections A, B, and C, of the committees original plan; and the latter the proposed classes D, E, and F, of that plan. This primary division appears to me to be more convenient in practice than a closer subdivision, for the reason that a nearly equal division of membership between those two classes accords more nearly with the relative numbers of cultivators of those sciences in this country and in the world generally, than any other divisions that can be proposed. As a matter of fact the cultivators of the Natural Sciences are more numerous than those of the Physical Sciences, as the relative extent of the literature of the two divisions indicates. I do not suggest that this preponderance of the Natural Sciences shall be represented in the National Academy, but that there shall be an equality of representation of the two. In a closer subdivision the relative numbers of members of each division is more likely to be variable, or for various reasons more difficult to ascertain, and thus more likely to cause dissatisfaction from time to time.

The division into the two classes of the Physical and Natural Sciences does not, however, embrace all the sciences, and is hence defective. It does not take into account applied science, which it is necessary that we recognize, owing to our connection with the government. While we necessarily embrace members competent in this great field, we cannot open our doors to a large representation of it, since pure science is our principal aim. As most human industries are more or less perfectly applied science, we must necessarily strictly limit our membership in this direction.

The sciences which you have proposed to include in the class F, are Statistics, Hygiene, Philology and perhaps others. To these might be added the science of mind objectively studied, or Psychology, and also that of human industries treated historically and descriptively. This entire group (excepting Hygiene, which is applied science), differs from those of the Natural and Physical Sciences in that its subjects are penetrated and affected by the interference of the human mind.

I would therefore, propose the following division of the Academy's membership into four classes, two of which have been already adopted.

CLASS I.—Physical Science; (Sciences of energy); to include Physics, Astronomy, Chemistry, Physiology, and Dynamical and Chemical Geology.

CLASS II.—Natural Science; (Sciences of Morphology); Structural Geology, Mineralogy (apart from Chemistry) Biology (including Embryology and Paleontology).

CLASS III.—Anthropological Science (Sciences treating of phenomena determined by psychic conditions); Anthropology, Statistics, Philology, Psychology.

CLASS IV.—Applied Science. (Applications in the Arts of any of the Sciences previously enumerated); including Hygiene, Engineering, etc.

It will be observed that in the above classification geology is divided. This is inevitable, as the science is a composite one. Members might in this case choose whether they would prefer as geologists to be referred to Class I or Class II.

I would suggest that the members of each class be fixed as follows:

Class I, 35 members; Class II, 35 members; Class III, 15 members Class IV, 15 members; total 100 members.

It seems to me that both comprehensiveness and simplicity may be claimed for the above proposition.

Very respectfully,

Philadelphia, April 21st, 1894. E. D. COPE.

THE

AMERICAN NATURALIST

VOL. XXVIII. July, 1894. 331

ANIMAL MECHANICS.[1]

BY DR. MANLY MILES.

Reference was made to a former lecture before the Michigan Short-horn Cattle Association, in which the relations of heredity and variation to the improvement of live stock were discussed, and attention was called to the flexibility of the constitution of domestic animals that made them susceptible to the modifying influences of the conditions in which they are placed—so that variations are constantly produced by changes in food and management, and constant care must be exercised to select the animals presenting desirable variations to fix and retain them as inherited characters.

In presenting these fundamental principles in the improvement of animals, many important details were necessarily omitted, and at the present time my purpose is to supplement the general subject of heredity and variation, by calling attention to some of the latest contributions of science to the philosophy of feeding, and notice their relations to the principles of selecting breeding stock, that are often overlooked by inexperienced breeders in their efforts to improve their animals in special qualities.

In the lecture referred to, animals were compared to machines for converting the vegetable products of the farm

---

[1] Abstract of a lecture before the Michigan Association of Breeders of Improved Live Stock, Dec. 17, 1892.

into animal products of greater value. This simile, which is often made, is of greater significance than at first sight would appear, and if breeders will keep in mind the fact that they are, in effect, providing machines for doing work in the manufacture of meat, milk, wool, muscular power, or other animal products, from the raw materials derived from the soil, the means of improvement will be more readily understood.

From this point of view the breeders of live stock should have a deep interest in the general progress of agriculture, as any improvement in crop growing must be to their advantage, from the larger supply of raw materials for the manufacture of animal products, which should increase the demand for animal machines to perform the work with the greatest economy, and at the same time turn out a finished product of a quality than can be disposed of at renumerative prices in the market.

This simile of a machine makes apparent the fallacy of the old notion that the animal that eats the least is the best for the farmer. It would certainly be a poor recommendation for a machine to say that it could work up but a small amount of raw materials. The object of the farmer is, profit, and in every department of production the aim should be to obtain the largest net return from the raw materials he has to dispose of. The more the animal machine can do of useful work, the greater its value to the farmer, if the results are obtained with the greatest economy.

Another popular error will be readily corrected by looking upon animals as machines for doing work. The notion has too generally prevailed that animals are composed simply of flesh and blood and bones, etc., and that when they are furnished with food containing the materials which enter into the composition of their tissues, it would, in some mysterious way, be converted into animal substances. This is, however, a partial or one-sided view, that does not represent the whole truth.

Farmers are constantly dealing with the forces of Nature, and a knowledge of natural laws cannot fail to aid them in their mastery. The applications of the law of the conserva-

tion of energy to animal and vegetable physiology, which have recently been made, are of great assistance in giving clear and correct notions in regard to the economy of living beings, and we learn that the materials used in the constructive processes of plants and animals are not of greater importance than the motive power required to convert them into living substances.

The law of the conservation of energy has revolutionized modern physics, and the industries have been directly benefited by its applications, and its influence in agriculture when rightly applied, can hardly be overestimated. Faraday pronounced it "the highest law in physical science which our faculties permit us to perceive," and it has been claimed to be the most important discovery of the present century.

Energy has been defined as "the power of doing work, or overcoming resistance." Its familiar manifestations we call heat, light, motion, electricity, etc. These different forms of energy are mutually convertible, without gain or loss, or, in other words, the energy of the Universe is a constant quantity that is neither increased or diminished by the transformations it undergoes.

All forms of energy may be transformed to heat, and this furnishes a convenient unit or standard for measuring it. The unit of heat is the amount required to raise one pound of water one degree in temperature. Its mechanical equivalent is 772 foot-pounds, which is the unit for measuring work. That is to say, the heat required to raise one pound of water one degree in temperature, is equivalent to the force required to raise a weight of one pound 772 feet, or a weight of 772 pounds one foot, which is, conveniently expressed, as 772 foot-pounds, the weight in pounds being multiplied into the distance in feet through which it is raised. Foot-pounds divided by 2000 will give the result in foot-tons, which is often used.

When a weight of one pound is raised 772 feet, it represents, in that position, 772 foot-pounds of potential, or stored energy, and when this weight is allowed to fall the entire distance without interruption, the stored energy is transformed into active energy or motion, and when this motion is arrested on

completion of the fall of 772 feet, heat is liberated sufficient to raise one pound of water one degree in temperature, or, the equivalent of the energy required to raise the weight to the height from which it fell. This serves to illustrate what is meant by the conservation of energy.

The transformation of food constituents into animal subtance involves the performance of work by the animal machinery of nutrition, which is carried on at the expense of the stored energy of the food consumed. An expenditure of energy in work is as necessary to convert corn or grass, into animal subtance, as in the hauling of a load on the road, and the term work is as applicable, in the same sense, in the one case as in the other. Sheep growing wool, cows giving milk, and animals fed for the butcher, should, therefore, be recognized as working animals, as well as those used in draft, or in lighter, more rapid work on the road.

Internal work must be done in the first place to convert vegetable substances into animal substance; and, in the next place, an additional amount of work must be done in the further conversion of animal substance into the special animal products of meat, milk, wool and muscular force, which are the real sources of profit in feeding. Moreover, this internal work involves the wear and tear of the animal machine, which unlike purely mechanical devices, makes its own repairs at the expense of the raw materials it is its mission to convert into animal products.

An important question here presents itself; how is the food consumed by animals disposed of, and what purpose does it serve in the animal economy? The correct answer to this is of great practical importance and interest to every farmer, and especially to breeders of improved stock.

In the first place, materials are provided for growth, and for the needed repairs of the system, but only a small proportion of the food constituents are utilized for these purposes, as will be seen from the following table giving the results of experiments at Rothamsted.

Each 100 pounds of food constituents consumed by fattening animals were disposed of as follows:

Constitutents of Food. 100 lbs. each.	Stored in increase.			Voided in Excreta.		
	Oxen.	Sheep.	Pigs.	Oxen.	Sheep.	Pigs.
	lbs	lbs	lbs	lbs	lbs	lbs
Proteids	4.1	4.2	13.5	95.9	95.8	86.5
Non-proteids	7.2	9.4	18.5	14.1	8.9	4.1
Minerals or Ash	1.9	3.1	7.3	98.0	97.0	92.7
Dry Substance	6.2	8.0	17.6	36.5	31.9	16.7

The food constituents not accounted for have served a useful purpose in their liberated energy for the performance of work, and their residues have been exhaled in the gaseous form, and the surplus energy as animal heat. Growing animals, and cows giving milk, will retain, or utilize a larger proportion of the food constituents, but even then much the larger part of the material elements of the food are discharged in the excreta.

In the next place, the potential or stored energy of the food is made available in all of the work done by the system, and it is the sole source of power in all of the processes of the animal machine.

From the prominence given to the chemical theory of nutritive ratios in some of our agricultural papers, farmers are asked to believe that success in feeding depends upon following certain theoretical formulas, giving the proportions of food constituents in the rations fed, while the animal machine which does the work of manufacturing valuable animal products, and the motive power that makes it efficient, are entirely ignored. I can only say in passing, that in the present state of knowledge, we cannot formulate the constituents of foods in chemical terms, to serve as practical guides in feeding. The machine itself, is the most important consideration, and its capacity, for doing the work required of it, is of far greater significance than the proportions of the comparatively small amount of the so-called nutritive constituents stored up, or used by the animal.

Let us for a moment consider the facts in regard to the construction and repair of other farm machinery, as reapers, mowers, threshing machines, etc. When ~~we take~~ an exact inventory of the items of cost, in the construction and repair of these machines, we find that the materials of which they are made, or are used in repairing them, make but a small fig-

ure in the expense account, and that the work done in shaping and fitting the materials in proper relations, represent a very large proportion of the real cost of the machine or of the repairs that may be made. In repairing a machine, a few cents may pay for the iron or wood used, while several dollars would be required to pay for the work done.

The same principle holds good with the animal machine, both in its original construction and its repairs. But a small proportion of the food constituents are utilized in the processes of nutrition, and a very large amount of energy is constantly expended in the work of transforming these materials into animal substance and animal products.

The real significance of these facts will best be seen by making a quantitative estimate of the energy expended, and the transformations it undergoes in organic processes, as represented in the following table giving an approximate statement of the composition of one acre of corn, and of a fat ox analyzed at Rothamsted.

	Constituents	Corn one Acre. 3360 lbs. grain 3840 " stalks 7200 lbs. total		Fat Ox. Fasted Live Weight, 1419 lbs. (Contents of Stomach, etc., 85 lbs.).	
		Per cent.	Lbs.	Per cent.	Lbs.
A	Carbon	39.7	2858	31.6	448
	Hydrogen	7.0	504	9.7	137
	Oxygen	48.8	3511	46.5	660
	Nitrogen	1.3	90	2.4	34
	Ash	3.3	237	3.9	55
	Potash	1.10	79	0.18	2.6
	Phos. Acid.	0.53	38	1.55	22

B	Water	17.1	1282	45.5	646
	Proteids	7.8	562	14.5	206
	Fat	3.3	237	30.1	427
	Carbhydrates	68.5	4932		
	Ash	3.3	237	3.9	55
	Potash	1.10	79	0.18	2.6
	Phos. Acid	0.53	38	1.55	22

	Stored energy representing work done.	17,083,000 foot-tons, equivalent to the work of one horse continuously for 719 days.	3,381,000 foot-tons, equivalent to the work of one horse day and night for 142 days.

A chemical analysis of the corn shows (division A of the table), that it is composed of 2858 lbs. of carbon; 504 lbs. of hydrogen; 3511 lbs. of oxgen; 90 lbs. of nitrogen; and 237 lbs. of ash, or mineral constituents, the most important of which are potash 79 lbs., and phosphoric acid 38 lbs. The ash constituents and the nitrogen are alone derived from the soil.

We have here the elements of which the crop is composed, but division B of the table shows that they represent water 1232 lbs.; proteids 562 lbs.; carbhydrates 4932 lbs.; and ash 237 lbs. These are the facts furnished by chemistry in regard to the composition of the acre of corn, but they do not represent the whole truth.

To transform the simple elements of division A of the table into the complex organic compounds of division B, energy must be expended and work done, and the energy so used is stored up in the organic substances formed as an essential condition of their constitution. The amount of this stored energy is represented in division C of the table, and it is an important factor in the composition of the crop of corn, as it is one of the essentials in animal nutrition.

This stored energy of the corn does not, however, represent the total expenditure in the growth of the crop. Experiments show that for each pound of dry organic substance formed by the growing corn, about 300 lbs. of water will be exhaled, or thrown off by the plants in the form of vapor. To convert water into vapor involves an expenditure of energy, and this for the acre of corn would be approximately equivalent to the work of 24 horses for six months without intermission. Water is likewise evaporated from the soil as one of the essential conditions of fertility, and this calls for a further expenditure of energy, which under our climatic conditions may be estimated at about twice the amount expended in exhalation from the plants themselves. Taking all of these processes together, the

energy expended directly and indirectly in Nature's invisible unobtrusive work of growing an acre of corn, must be equivalent to the work of 76 horses, day and night, for six months.

This energy is all derived from the heat and light of the sun. The importance of proper soil conditions to favor the required transformations of energy in the growth of the crop will readily be seen.

The motive power of the animal machine, in all of its processes of nutrition and growth, is derived exclusively from the stored or potential energy of their food, and we may ask how this energy is liberated and made available in the animal economy.

As the energy used in its construction is stored up by the plant as an essential condition of its constitution, any disintegration of its organic substance will liberate the stored energy in the form of heat. This may be brought about in several ways. 1.—The plant may be burned, and the heat produced represents its stored energy. 2.—Microbes feeding on organic substances tear them apart and liberate the stored energy in the form of heat. The heat produced in the familiar processes of fermentation and putrefaction, all of which are caused by microbes, is but the stored energy of the organic substances on which they feed. 3.—The digestive processes of animals involve a disintegration of the food constituents, and liberate their potential energy for use in the processes of animal nutrition.

Turning now to the table, for the composition of the fat ox, we find it represented in division A, as consisting of simple elements, and in division B the complex compounds built up from these elements are given. It will be seen that work has been done, and energy expended in transforming the simple elements of division A into the complex compounds of division B, and, as in the case of the corn, the estimated amount of this expenditure of energy is given in foot-tons, and horse power, in division C of the table.

The popular notion that the proteids, fat and carbhydrates of the corn are directly converted into the proteids and fat of the ox that eats them, (division B), does not take into account

all of the factors concerned. We have seen that energy must be expended in work to convert vegetable substances into animal substances, and this energy can only be obtained by tearing apart the vegetable compounds through the processes of digestion, and liberating their stored energy. In this process the vegetable compounds of the food are resolved almost into their elements, and from these comparatively simple substances by means of the energy liberated, the proteids and fats of the ox are manufactured.

The complex animal substances thus formed are continually undergoing change. The wear and tear of the animal machine involves a disintegration of its organic substance, and its stored energy is liberated as heat. This may in part be used again in the processes of repair, but a large proportion leaves the body as animal heat.

As in the case of the corn, the stored energy (division C of the table), of the fat ox does not represent all of the energy expended in building up its organic substance. A constant process of repair has been going on to replace the waste resulting from the wear and tear of the system, which involves a continuous expenditure of energy—and the loss arising from the energy thrown off from the body as animal heat, (radiation), and expended in vaporizing the water exhaled from the skin, (perspiration), must be replaced at the expense of the stored energy of the food to keep the machinery of nutrition, in efficient activity.

The facts presented are sufficient to show that the transformations of energy are important factors in the economy of plants and animals, and that the materials of which they are composed cannot be looked upon as the sole subjects of interest in farm economy. The tendency to make the compounding of food rations the prominent subject for consideration, conflicts with the interests of the breeders of improved stock, and misleads the farmers who are induced to look upon it as the real source of profit. This reference to the subject of feeding is made with the two-fold purpose of calling attention to the fallacy of feeding experiments in which the chemical composition of foods is made the prominent or sole object of interest,

while the importance of the improvement of the live stock of the farm is wholly ignored; and to remind breeders that they are fully warranted in claiming that improved animals are entitled to the first place among the means of an improved agriculture, as machines for manufacturing the crops grown on the farm into marketable products.

The most serious obstacles to the progress of agriculture at the present time arise from the one-sided and misleading statements that are made in the name of science by those who have but a superficial knowledge of Nature's laws, and their intimate relations to farm practice. The experiment station reports, on the feeding of animals, fail to give a full statement of all of the factors that may influence the results, and too often the record is made to conform to hasty assumptions, or false theories, so that it is difficult to find a grain of truth in the mass of chaff that is scattered broadcast over the country.

As the remarkable progress made in other productive industries has been largely owing to improvements in machinery, so progress in agriculture must depend, to a great extent at least, upon the further improvement of the animal machines that are so essential to success in the business of farming, and we must look to the breeders of the pure breeds to accomplish this desirable object.

It will not answer to rest satisfied with the present high development of the pure breeds and their more general diffusion on the farms of the country, but the aim of every intelligent breeder must be to still further increase their useful qualities in special directions. Notwithstanding the decided superiority of the pure breeds over the average farm stock, there is still a wide margin for improvement, as there are good reasons for believing that even the best animals do not utilize more than one-half of the available energy of their food in useful work.

The largest profit can only be realized with animals that have the ability to consume and utilize in useful work, an amount of food considerably in excess of what is required in the needed repairs of the system. This involves severe work,

and one of the first essentials to be considered is that of stamina and constitution, or, in other words, the capacity for hard work and powers of endurance, or the same qualities in this respect that all working animals should possess.

These qualities are largely determined by heredity, and selections for breeding purposes should be made with reference to these qualities in the ancestors. Good sanitary conditions must of course be maintained, to secure a continuance of robust health and an active performance of the normal functions of nutrition.

PREPOTENCY.

Strength of constitution or powers of endurance must not be confounded with prepotency, or the quality of holding a preponderating influence in the act of reproduction. Many animals that are prepotent in transmitting their own qualities, are deficient in constitution, and their offspring lack that active and vigorous performance of the nutritive organs that is essential to stamina and powers of endurance in useful work. Prepotency arises from uniformity in the characteristics of ancestors for many generations, and these characters may or may not be desirable.

In the improvement of the pure breeds with. their present high development of valuable qualities, an accumulation of slight variations must be the aim. We cannot expect to gain any wide departure from present characters at a single step. Progress can only be made by a succession of short steps, and their sum will represent the real advantage gained. Small items determine the difference between gain and loss in the present activity of the industries, and in agriculture we must recognize the importance of slight improvements in each detail of general management as the only available method of making real progress.

BREEDING TO A TYPE.

In making selections for breeding, an ideal type of excellence representing definite valuable qualities, should be strictly

adhered to. This type, in all cases, should represent the highest development of characters that indicate the posession of the desired useful qualities. The form should be that which represents a special adaptation to the particular purpose in view. It is well known that the general form of animals is correlated with particular functions. The form of the roadster differs from that which is suited for heavy draft, and the type for rapid meat production is different from that giving the best results in the production of milk.

The law of correlation has, however, a further application. There is not only an adaptation of the general form to the kind of work that can best be done, but the different organs of the body have correlated relations that are quite as significant. An excessive activity, or development of one organ, or set of organs, diminishes the activity or development of the system in other directions. That is to say, the system has a capacity for utilizing a certain amount of energy, and if it is largely expended in one direction there is less to be expended for other purposes. If the tendency to lay on fat predominates, the milk producing functions must suffer a corresponding diminution, and severe muscular work will diminish the tendency to lay on fat, or produce milk.

To give permanency and uniformity to the ideal type that has been adopted, selections for breeding must be strictly confined to animals having the desired characters, within the limits of a distinct breed, or of a single family of a distinct breed. This is in effect establishing, or fixing, family characters in the particular breed. The constitution or physical stamina of the family type should not be lost sight of in attempts to secure other desirable characters, as on it will depend the efficiency and profitable exercise of the special functions that have been cultivated and fixed as family characters.

All coarseness should be avoided. Improvements in all breeds have been made by securing a greater refinement of the system, or in diminishing the proportion of coarse parts. Large bones, with apparent good reason, have been looked upon as an indication of imperfect nutrition, and as a general

rule, to which there are few, if any exceptions, they are correlated with coarseness in other parts. The wear and tear of the animal machine is greater in such cases, and a larger expenditure of energy is required in its repairs.

INHERITED HABITS.

Aside from the general inherited habits of animals with which you are all familiar, as the tendency to early maturity, or the habit of milk production throughout the year, or in what is called the trotting instinct, there are inherited habits of the nutritive organs themselves which should not be overlooked.

Habits are cultivated and established by their systematic exercise, and the desirable habits of the nutritive organs can only be cultivated and maintained by their constant exercise, or, in other words, by liberal feeding, and the direction in which the liberated energy of the food is expended must, at the same time, be determined and promoted by cultivating the general and special habits of the system. If, for example, milk is a leading object, in connection with a liberal supply of food, from which energy is freely liberated through the inherited activity of the nutritive organs—a sufficient capacity of the udder and other organs concerned in milk production must be provided—and a dominant tendency to the expenditure of the available energy in the milk producing function must be kept up by gentle treatment and regularity in milking and feeding. Judgment and skill must be exercised and attention given to many details, all tending in the same direction, to give the desired bias to the energies of the system.

The application of general principles will be found a better guide in practice than any specific empirical rules, and the habits of the system developed by judicious exercise and cultivation, must be fixed by systematic selection as hereditary characters.

GENERAL PURPOSE ANIMALS.

We can only call attention to some of the principles already presented to illustrate this special subject. There is, undoubt-

edly, a greater difficulty in securing two qualities on a high plane of excellence, than to obtain an extraordinary performance in a single special direction.

Milk and meat production are not strictly incompatable, and a high degree of excellence may doubtless be obtained with both. Greater skill is, however, required to combine the two qualities and retain them for any time, than to obtain a high development of either of them alone. A certain balance, or equilibrium, in the expenditure of energy, must be secured in the general purpose animal, or there will be a tendency for some single quality to predominate.

A tendency to the expenditure of energy in one direction during the period of growth, and in another direction when maturity is reached, may be cultivated and fixed by heredity. This principle is an important one for consideration in breeding dairy stock. When a cow is giving milk the tendency, or inherited habit of the organs of nutrition, may be to expend the entire energies of the system in the milk producing function, and when she becomes " dry," the available energy may be expended in laying on fat. The difficulty is, however, to maintain a due balance of the two functions. If the fattening tendency predominates, the period of giving milk may be shortened and the activity of the function ultimately diminished. One of the best precautions against this is to retain in perfection the milking type in the general form of the animal, and to keep up the milk secreting function as long as possible by proper management. Constant care in the selection and treatment of the animals will be required to secure the most desirable balance between the two functions, and prevent a predominance of either.

EXERCISE AS A FACTOR IN IMPROVEMENT.

From the general principles already noticed, it must be seen that the exercise of special organs, and of the general system, are necessary to secure the highest excellence in the working of the animal machine. We must keep in mind the fact that the exercise of an organ or group of organs, involves an expenditure of energy, and what is spent in one direction can-

not be used in another, that is to say, that work performed by one organ diminishes the amount of energy to be expended in work by another. Judgment is, therefore, required to adopt the exercise, in a particular case, to the requirements of the system for a special purpose.

The general exercise of the muscular system is undoubtedly desirable in growing animals to secure the symmetrical development of all organs, or parts of the body. Even in the process of growth a bias, or tendency to the expenditure of energy in a particular direction may be encouraged. This is illustrated in the Palo Alto training of youngsters. Culture and heredity have given the remarkable development of the trotting horse, and early culture, or training, is now looked upon as one of the most encouraging factors in future improvement.

In the animal raised for meat production, early maturity is essential, and the tendency to flesh forming may be encouraged from birth. Exercise of the general system in the early stages of growth should tend to promote the development of muscle, or lean meat, and check the tendency to excessive fat production.

While recognizing the advantages of muscular exercise during growth, in promoting the formation of lean flesh, and a symmetrical development of the system as a whole, we must not overlook its unfavorable influence under other conditions. In the case of a cow giving milk, or in that of a fattening animal, muscular exercise must result in a diversion of energy from the work of milk production or flesh formation. Any considerable amount of muscular exercise by a cow giving milk must tend to diminish both the quantity and quality of the milk produced, or at least diminish the total amount of the solid constituents of the product.

QUALITY OF MILK AND ENERGY.

A large mess of milk may be produced with but a small quantity of solids, and a corresponding small expenditure of energy. The best milk contains very much more potential energy than poor milk, and it must cost a corresponding expenditure of energy to produce it. In other words, more

work is done by the animal machine in making good milk than in turning out an inferior article containing a larger proportion of water.

SEX INFLUENCING THE TRANSMISSION OF HEREDITARY CHARACTERS.

From the manner in which pedigrees are recorded in some of the herd books, there is a tendency to overlook the characteristics of the female ancestors, which, especially in the dairy breeds, are of great importance. In the chapters on "atavism," and "the relative influence of parents" in my "Stock Breeding," a number of cases are collected showing that sex has an influence on the transmission of characters. A sexual alternation in the inheritance of dominant characters is often observed, female peculiarities being more strongly transmitted to male offspring, which they in turn impress upon their female offspring; and male characters are in the same way transmitted by females. This should not be overlooked in breeding dairy stock, as the milking qualities of the grand dam frequently appear to be transmitted to her grand daughters with greater intensity, and certainty, by her sons than by her daughters. The female ancestors of the bull in a dairy herd must, therefore, be of especial interest in his pedigree, as an index of the qualities he will be likely to transmit as dominant characters to his daughters.

The means of improving animals in useful qualities may be expressed in a few general principles, and the success of the breeder will depend upon their judicious application under the circumstances presented in each particular case, and every detail of practice must conform to them to secure the best results.

The most valuable qualities of our domestic animals are the outcome of highly artificial characters, representing a wide departure from the original stocks from which they sprung; and if the same artificial conditions that produced them are not maintained, and the selection of breeding stock is not limited to the animals that have the desired characters, they are

readily impaired and finally lost. The old race characters, under careless management, have an advantage over the more unstable acquired characters that give the animal its greatest value.

Pedigrees must be studied to ascertain whether all ancestors have had the desired qualities. Cross breeding, in the widest sense of breeding together animals of distinct breeds, would not now be defended by any intelligent breeder, but the same principle is frequently acted upon in breeding together different families of the same breed, and unless there is a strong prepotency on the one side, the advantages of such crossing must be at least problematical.

Uniformity in hereditary characters, so far as we know, can only be secured by breeding together animals having the same characteristics.

The whole matter of successful breeding may be summed up in the two words "culture" and "heredity," and in the selection of breeding stock it is desirable that all ancestors should have had the required form of culture, or training, in order to secure uniformity in hereditary characters.

THE MEANING OF TREE-LIFE.

By Henry L. Clarke.[1]

(Continued from Volume 28, page 472).

It is a striking fact that the older fossil forest remains, at least through the Paleozoic and early Mesozoic strata, present a wonderful likeness in character the whole world over. The wide scattering and spreading of types that this indicates, is to be directly accounted for partly by the more frequent physical changes that took place in early geologic times, and the constant changes and shiftings in the relative positions of continental surfaces, through upheavals and subsidences; and in part by the wide wind-dispersion possible for the spores of the Paleozoic Cryptogams. Past question geology makes countless blunders in assigning strata in different parts of the world to the same age because of likeness in their fossil flora (and the statement holds almost equally true of fauna), where likeness is in fact a positive proof that the strata are not synchronous. But the chances for error in this direction decrease from the latest to the most remote ages. All evidences indicate more and more homogeneous climatic and physiographic conditions as we trace the geologic record farther and farther back.

When the low insular character of the early continents, and the consequent increased humidity of the atmosphere extended a nearly sub-tropical climate to the poles, it is obvious that the potency of the sun as a maker of the seasons and and zones, counted for far less than now,—unless indeed the sun itself were tremendously hotter then than now. But that this last supposition is false within the history of vegetation is proven by a simple fact. Were it true, the equatorial zone would have been a region of such intense heat that it would have formed an impassable barrier between the floras of the

---

[1] University of Chicago.

north and south polar regions; whereas, on the contrary, we find identical types to the far corners of both hemispheres.

It is a vitally important consideration that a slight increase in general atmospheric humidity would have the effect of converting the atmosphere into a heat-distributing oven.

We cannot indulge in the absurdity of asserting separate centers of identically similar development, and we know that the torrid zone of even the present would be impassable to perhaps 99% of our far north temperate flora; so here is proof sufficient of relatively great homogeneity in the conditions of the far past, and increasing heterogeneity thence down to the present. Aside from the greater stability and ruggedness of modern continents, the change that has wrought an all important effect upon vegetation, has been the development of the modern widely extended continental land-areas, producing a secular diminution in the general humidity of the earth's atmosphere, with the consequent full development of the great climatic zones, the polar, temperate, and torrid. Probably in the later Mesozoic and early Tertiary, this change began to make its influence most strongly felt, and through the Tertiary down to the present its effect has steadily and rapidly become more and more obvious. The fact is of course not to be lost sight of, that the highly specialized Mesozoic and Tertiary floras would be far more susceptible than the more lowly Paleozoic to climatic changes. But the working of these changes has been all-powerful in making most of the problems of geographic botany that are before us in the present, and so we may here fittingly turn the course of our discussion in this direction.

The progressive changes from the comparative homogeneity of conditions in remote ages to the world-wide heterogeneity of the present, have been recorded in the development of more and more complex tension systems between the various factors of vegetation. Of these systems, the most primitive was that belonging to each individual forest,—a central stronghold of old established types, merging into a tensional margin line of newer, weaker forms. Wherever vegetation existed, this tension system must have existed; but while we see it in the

present world under an indefinite variety of aspects, probably in Paleozoic times a study of the tensions of one forest would have been, in the main, a study of all others. The far more homogeneous climatic and physiographic conditions then prevailing, must have meant almost as striking world-wide similarity between all forest tracts, as there is now bewildering diversity. New forms were far more rapidly dispersed from the localities where they originated, and wherever they migrated they found conditions practically similar and hence equally favorable. Thus within a comparatively brief range of time, closely similar floras might have been found in widely separated regions. But another factor came into play at an early period to greatly complicate the problem—the physiographic irregularities in continental surfaces. The increasing stability of physiographic features from remote toward modern times, has made these features vastly more complicated and diverse now than in ages past, and consequently their influence on vegetation has become more and more profound. The earliest, as well as all the subsequent manifestation of this influence, was the development of a second great system of tensions—tensions between the unlike vegetations of adjacent unlike country surfaces, between the swamp and the dryer plain, the flat country and the hills, the mountain sides and the valleys. Here the tensional margin lines of two diverse hosts of vegetation met and formed another tension line between their own, and on this, the struggle for the mastery waxed fiercest, and the evolution of highly specialized forms was most active.

Such were the two tension systems of preeminent importance in the early history of plant-life; later a third came upon the stage, brought into existence through the development of the great climatic zones. Probably this first began to assume decided importance, as has been pointed out, sometime in the later Mesozoic, and increased the range of its influence through the Cretaceous and Tertiary, till in modern times, it has culminated in producing the broadest and most fundamental division of the world into great botanical realms. That there were regions of glacial cold in Australia, India, and Cape Colony in Carboniferous times is an undoubted fact;

that there were regions of glacial cold in previous, as well as several subsequent, ages is highly probable; but this does not invalidate the general principle suggested here. The reconstructive meteorology of the near future will probably demonstrate that the geographical distribution ot the Carboniferous glaciation, and of several other similar cases, is directly connected with peculiar stages of continental evolution and oceanic extension. And while such glaciations are of far-reaching importance for their age, they are nevertheless temporary " perturbations " that do not, in the long range of time, break down the secular increase in the direct subordinating of the zonal world-climate to astronomical, rather than terrestrial, influences. From a nearly homogeneous climatic condition throughout the world, there were gradually developed five fairly distinct zones merging into each other at their adjacent margins—a torrid equatorial, frigid polar, and temperate intermediate. Their development inevitably had a profound effect on vegetation. In the fossil forest beds of Cretaceous times in far northern regions, there have been found side by side Cycads, Conifers, Palms and Hardwood trees, a conglomeration utterly bewildering to the botanist of to-day, but nevertheless a typical indication of the relatively homogeneous climatic conditions of the age when such a forest could have existed.

With such a suggestion of the Mesozoic world before us, let us watch the great climatic zones develop. It is the tree-life of the forests that tells the story most clearly; to it belonged preeminently the all-important mission of remodeling the aspect of the world's vegetation. The trees moved their habitats, and the herbaceous forms were carried along with them. In the equatorial belt were all the conditions of heat and moisture most favorable to the vigorous development of plant life; in the polar regions that sternest foe, steadily increasing cold; in the temperate belts, a compromise between the conditions of the others. From the original mixed forest a selection had to be made of the tree-groups that were to hold dominion respectively over each of the new sets of conditions. How? It will not do to say glibly, the Palms

loved the heat, the Conifers the cold, and the Hardwood trees the happy medium. Conifers luxuriate to-day in the torrid zone, and Hardwood trees and modern congeners of the Palms once grew together in Greenland. No innate partiality for heat or cold separated the three great groups, but the stern laws of plant dynamics that determine the course of the struggle for existence. The old established and all-powerful tree-group, the patriarchs of the forest, were the Conifers, the group best fitted to stem the tide of change and battle with opposing conditions; next them in power, because most like them in character, were the Diclinae; and weakest were the Palms, the group whose foot hold was most precarious. These last could hold their own against the powerful Conifers and Diclinae only so long as climatic conditions were most favorable. Consequently, as the cold advanced from the polar regions the palms retreated toward the torrid zone. Here they took their stand, their highly specialized structure asserted its full power, and gradually they crowded out the Conifers and Diclinae, and established preeminent dominion over the equatorial belt. The Diclinae and Conifers were crowded out, "not that they loved heat less, but that they loved freedom more." They were fitted to maintain themselves against the cold of extratropical regions, and in these regions they were relieved from the struggle with a powerful competitor, the whole family of Palms and its associated rank luxuriance of tropical vegetation. In short, the strength of the Palms when congested into the equatorial belt, more than counterbalanced the loss sustained by the coniferous and hardwood trees in the cooling of extra-equatorial regions. And so the Palms, and with them the remnant of their ancient allies, the Tree-ferns and Cycads, claimed the tropics for their heritage. There was probably no region of the world where Conifers had not gained a strong foothold in the long course of ages; there is scarcely a corner of the modern plant-world that does not hold some group of them; and it was the Coniferæ that obstinately held their own against the cold of sub-polar lands, with the stubborn endurance that four great eras of geologic time have helped to build.

The Diclinae retreated before the advancing cold into more temperate climes, retreated in fact until they gathered strength to wage equal battle with their mighty coniferous opponents.

Here, in the temperate zones, the Diclinae stood fast and crowded the Conifers outward toward the polar regions, not toward the equatorial, for there the odds agaiut the emigrants would be tenfold increased. The record of this battle of the trees is stamped upon many of the forest monarchs that we marvel at to-day. A recent writer has well said: "Just as in the formidable armor of some extinct armadillo one may read somewhat of its struggles with its enemies, so in the one hundred meters of solid trunk and in the massive girth of a living Sequoia gigantea, the giant red-wood, one may learn of its struggles in the ancient forests of Cretaceous and Tertiary times, when its allies and competitors were alike more numerous."

The third great tension system is now unfolded before us. We see the hardwood forests of temperate regions facing on the one hand the congested luxuriance of equatorial vegetation, and on the other the ancient coniferous forest gathered round the poles and step by step forced backward by advancing cold. There is a great equatorial pressure toward the poles, and an opposing polar pressure, traceable to opposite causes; and between them there is a broad tension line, the temperate zones. Conway MacMillan, who was quoted just above, has proposed a broadly generalized division of the world into two great botanical realms, the Central Realm and the Distal Realm. But the division should be carried a step farther; taking the three great forest elements as a guide, we may fully express the evolutionary history of plant dynamics by recognizing three great divisions:—

The Central Tropical Realm, the Tensional Temperate Realm, the Distal Sub-Polar Realm. The three merge into each other and their elements are everywhere somewhat commingled, but in the main they are fairly distinct. Such was the general plan of the plant world of the late Tertiary, proximate Preglacial times. The Glacial Period had a wonderfully interesting effect in modifying the northern

portion of it. The story has been often told, but one aspect of it will deserve further attention. Out of the various forests of north temperate regions, we may recognize four that are of peculiar interest. The European, the Northeast Asian, the Appalachian, and the Pacific North American. All are relics of the preglacial northern forest, but they are relics in very different stages of preservation. The Northeast Asian is a marvel to students of tree-life in the abundance and immense variety of its forms. Evidently it has best preserved the characters of the primaeval forest. The poverty of the European forest is equally striking and has been well explained by the fact that the east and west mountain chains and the Mediterranean to the south were fatal to the vegetation retreating before the advancing glaciers. The Atlantic North American, or Appalachian forest, on the contrary, was well preserved by the physical characters of the country, and in its perfection is second only to the Northeast Asian. But the Pacific North American is an anomaly. It is preeminently a forest of Conifers with an astonishing poverty of hardwood types, although the latter are abundant as fossils in the Tertiary strata of the region. But is this such an enigma as it has often been considered? The ice sheet that swept over the Great Lakes and down into the Mississippi Valley did not reach that Pacific forest region of the United States, but its influence was felt there none the less surely. Before it retreated—first the Hardwood forest, and close on its heels the Coniferae. The Coniferae invaded the strip along the western slope of the Rockies, and also the great Northeastern Asian forest region, and remained in both, about equally strong in number of species. But in the case of the first named region what became of the Hardwood forest that pushed ahead of the Conifers? Behind it on the east were the Rockies; before it on the west the Pacific; and to the south the stern physiographic obstacles of the Mexican coast. And again, what was the character of the coniferous forest that invaded the Pacific strip? We need only point to the two Sequoias, sempervirens and gigantea, the "Big Trees" of California, the culminating triumphs of vegetative energy in Coniferae. The

Pacific strip became the refuge and stronghold during glacial times of the mightiest phalanx in the North American coniferous forest, and there they have stayed, simply because all competitors perished before their invasion. Obviously the conditions in the case of the Asian coniferous invasion were vastly different; while the comparative poverty of the coniferous element in the Appalachian forest is directly traceable to the strength of its hardwood element and the path of retreat afforded the Conifers toward the north and northwest.

A remarkable example of the development of higher types along the tensional margin-line was the glossopteris flora of the Carboniferous glacial regions,—a flora an age ahead of that of the rest of the world, and developed where the latter flora was beaten back by the glacial cold.

Many details of great interest to the systematic botanist might be outlined in this connection, but what has been suggested suffices to show how vitally important is the chapter of plant-history recorded in the world's tree-life. It will be found on comparison, that the record of the development and migrations of shrubby and herbaceous plants closely accords with the history of the tree-groups with which they are most closely allied. But the stability of tree characters vastly exceeds that of the characters of the lesser plant forms, and hence it is these latter that vary most in passing from one region to another. Still in this latitude we may clearly observe that the more ancient herbaceous forms are the more northerly in their range, and the newer the more southerly. The equatorial belt has become the great center of developmental activity, and out from its congested tension-margins come the vanguard of our highest floral types. The coniferous trees were all-powerful in the Mesozoic; the Hardwood trees of the amentaceous and choripetalous Dicotyls seem to have reached a climax of luxuriance in the late Tertiary; and out of the great element of sympetalous Dicotyls that predominate the herbaceous flora of the present world, there may be developed another great tree group that shall rule the forest of the far off future. The promise of this last is already to be found in the arborescent Compositæ of certain of the Pacific

islands. But it is certain that forest development in the future will follow no such clearly defined courses as in the past; the wonderful complexity of the geographical botany of the present has forever sealed the possibility of another distinctive tree-group attaining such a world-wide prominence as either the Conifers or the Diclinae or the Palms. These three must stand alone as a unique monument to the struggle for existence in the primaeval Mesozoic forest. For even as the conditions of that age made possible a remarkably homogeneous plant world, even so the great tension system of the earth's present vegetation makes diversity, to an equally or more remarkable degree, the key-note of future development.

LEPIDOSIRENIDS AND BDELLOSTOMIDS.

By Theodore Gill.

I.

In the American Naturalist for November, 1893, Dr. Howard Ayers has published an article " on the genera of the Dipnoi Dipneumones" which exhibits a characteristic—" lumping "—which, may sometimes be a virtue but which, in this particular instance, has been exaggerated into a decided fault.

In 1885, Dr. Ayers created much astonishment among naturalists familiar with the history of the Lepidosirenids by not only refusing to admit the generic differentiation of *Lepidosiren* and *Protopterus*, but by contending that the representatives of the two genera were even *specifically inseparable,* and that the American habitat of the type was doubtful!

In the article just cited, Dr. Ayers has given a reluctant and grudging admission to specific rank of the two types but has unqualifiedly denied their higher rank; grudgingly, because he concludes that " if they had to be named as new discoveries to-day, and could be studied together in so doing, most zoologists would include both animals in one genus, *even if they did not group them as varieties of one species* " (p. cit., p. 922).

Dr. Ayers' former article has been sufficiently answered by Baur, Schneider, and Parker, and his last article fails to invalidate their contentions. I shall only add that, after a comparison of the entire body as well as the skeleton of *Protopterus annectens* with the descriptions and figures of the corresponding parts of *Lepidosiren paradoxa,* I am convinced that no zoologist of mature experience would hesitate to rank *Lepidosiren* and *Protopterus* as *very distinct genera.*[1]

---

[1] Professor Ray Lankester, in "*Nature*" for April 12, 1894, (p. 555), has announced that he recently obtained, "by purchase from a London dealer, specimens of the Lepidosiren of the Amazon well preserved in spirit" (how many he has not told). He has illustrated peculiarities in "the limbs of *Lepidosiren paradoxa,*" and we may soon expect more details from that accomplished naturalist.

II.

In the article in the Naturalist (p. 923), Dr. Ayers claims to "have ascertained that, taking all the *Bdellostomids* together, they form a series in which the gill variation runs between the minimum of 6 pairs and the maximum of 14 pairs, or a DIFFERENCE BETWEEN THE EXTREMES OF 8 PAIRS OF GILLS, AND YET ALL THESE INDIVIDUALS NOT ONLY BELONG TO THE SAME GENUS—THEY BELONG TO THE SAME SPECIES!" (Big type and exclamation mark are Dr. Ayers' own).

In "Biological Lectures" delivered at Woods Holl in 1893, lately published, is reproduced (pp. 125–161) a lecture by Dr. Ayers on "*Bdellostoma dombeyi* Lac.; A study from the Hopkins Marine Laboratory." Therein Dr. Ayers has urged at length the contention just cited and has categorically stated that "the number of gills of individuals from *different localities* varies from 6 on either side to 14 on either side, with the observed intermediate stages" (p. 137).

Dr. Ayers' own record of his observation (p. 140) and summary of those of his own as well as of others (p. 156) will be an all-sufficient refutation of this claim.

"In the material which [he] was able to collect at Monterey, the following proportions of the several variations prevailed:

104	individuals	had 11	gills	on	both sides.
26	"	" 11	"	"	one side.
		and 12	"	"	the other side.
208	"	had 12	"	"	both sides.
11	"	" 12	"	"	one side.
		and 13	"	"	the other side.
8	"	had 13	"	"	both sides.

354 total number of individmals counted."

In his summary of observations on the number of gills, he gives formulas for all observations as follows:—

"*Bdellostoma dombeyi* 6 gills.
" " 6–7 } indicating the sides of the body upon which the respective numbers occurs.
" " 7–6 }
" " 7
" " 10
" " 11
" " 11–12
" " 12–11
" " 12
" " 12–13
" " 13–12
" " 13
" " 14"

It will be noticed that there is a great gap from 7 to 10 which has been straddled, but for which there is not the slightest observational basis. The logical fallacy involved is too obvious to need more than pointing out.

On one hand out of 354 specimens examined by Dr. Ayers, 208 had 12 pairs of gills and 104 had 11 pairs of gills, while 26 had 11 *or* 12 on one side. Not a single one had less than 11. No specimen with a smaller number than 10 has been recorded from the Pacific Coast.

On the other hand, of many specimens obtained in New Zealand, South Africa, etc., all had 7 or 6 and none had more.

Are not these facts sufficient to prove the distinctness of the two types?

(1) There is a gap of from 7 (maximum) to 10 (minimum) at least, between the number of gills of the two types. (2) The range of variation, considerable as it is, is limited in both directions. (3) The differences in numbers are associated with differences in geographical range. Certainly, then, the two forms are specifically distinct. Are they not generically distinct?

Dr. Ayers has truly remarked (p. 152) "It seems to have become a settled belief among the large majority of zoologists of both morphological and systematic proclivities, that the number of gills found among vertebrates never rises above

eight pairs in existing forms." The deviation from this almost universal rule led me to propose the generic differentiation of "*Bdellostomids* with an increased number of branchiæ" from those "with typically 7 (sometimes 6)." Be it recalled also that the former have "the base of the tongue between the seventh or eighth pairs of gills," while the latter have "the base of the tongue between the anterior pair of gills."[2] The genera thus defined were named by me *Polistotrema* and *Heptatrema* (Proc. U. S. Nat. Mus., 1882, pp. 518, 520). These have been accepted by Jordan, Gilbert, the Eigenmanns, and others, and probably will continue to be. Dr. Ayers, however, has urged that "these accounts all refer to the varieties of what I shall call *Bdellostoma dombeyi*, adopting Müller's genus on account of the inapplicability of Lacépéde's *Gastrobranchus*, and of the inappropriateness of Cuvier's *Heptatremes*, which could only be used for the seven-gilled form or variety" (p. 155).

Gastrobranchus was a generic name formed for *Myxine* alone and of course could not be perverted to a *Bdellostomid*. *Heptatrema* can be used for the group to which it was applied with perfect propriety, even though the species deviate in having often 6 branchial apertures on one or both sides. A corresponding latitude of usage is so generally recognized by modern zoologists, that a defense of such procedure is unnecessary. Even if such an extreme view prevailed, however, there is the name *Homea* of Fleming available, and this was proposed many years before *Bdellostoma*.

There are several other questions that deserve attention, but I resist the temptation to consider them now.

---

[2] "The relation of the tongue muscle to the gills is of interest, and here again we find great variability. Müller found it to lie entirely in front of the gills in the 6 and 7 gilled forms from the Cape of Good Hope, and this condition obtains in *Myxine* so far as known. In *Bdellostoma* with 10 or 11 gills, the base of this muscle may lie between the 6th and 8th pair of gills according to Putnam. In the 12 and 13 gilled forms, I have found it between the 5th, or at most, the 6th pairs of gill-sacks." (Ayres, p. cit., p. 139, 140). No observational basis has filled the great gap between the "front of the gills" and the interspace between the 5th pair!"

THE ORIGIN OF PELAGIC LIFE.

(FROM PROF. W. K. BROOKS.)

Chapters VII and VIII of Brooks' Memoir on Salpa embrace a discusssion of this genus in its relation to the evolution of life, and in order to clearly present its position and significance in the economy of nature the author discusses at some length the conditions under which oceanic life has been evolved. He notes first that the marine animals are almost exclusively carnivorous. They prey upon each other to an almost incredible extent, and were it not for the extraordinary fertility of pelagic organisms the rapacity of the higher forms of life would bring about their own extermination. Mr. Brooks, in commenting on the abundance of marine life, instances the great schools of mackerel, the hunters of herring, which in turn swarm like locusts. In 1879, three hundred thousand river herring were landed by a single haul of the seine in Albemarle Sound; but the herrings feed upon copepods, each one consuming myriads every day. In spite of this destruction and the ravages of armies of medusæ, siphonophores and pteropods, the fertility of the copepods is so great that they are abundant in all parts of the ocean, and not only on the surface, for banks of them are sometimes a mile thick. On one occasion the Challenger steamed for two days through a dense cloud formed of a single species. But upon what do the copepods feed? And this brings the author to the important factors in the food supply of the animals of the ocean. The basis of all the life in the modern ocean is to be sought in the microorganisms of the surface. They consist of a few simple unicellular plants, and the globigerinæ and radiolaria which feed upon them. These organisms are so abundant and so prolific that they meet all demands made upon them. They are not only the fundamental food supply, but, according to the author, the primæval supply which has determined the whole course of the evolution of marine life.

Sameness of environment and lack of competition for space have tended to make pelagic plant life retain its primitive simplicity, but existing apparently under the same conditions is an infinite variety of animal life. How can this be accounted for? In tracing the phylogeny of Salpa, Mr. Brooks finds that the structure which is so well adapted for life on the high seas has come to it by the inheritance of peculiarities originally acquired by bottom animals in adaptation to the needs of a sessile life. In this connection the author states that the majority of the present pelagic animals have not been produced at the surface of the ocean by gradual evolution from a simple pelagic ancestor, but that part of their family history has been worked out by individuals who colonized upon or near the bottom, or along the sea shore, or upon the land, and the exceptions are all simple animals of minute size. He reviews the chief groups of metazoa to demonstrate this fact and gives, as notable exceptions, some of the veiled medusæ, a few of the primitive annelids, possibly, and the copepods among the crustacea. Among the higher forms, the fishes, which at first sight would seem to have been pelagic from the beginning, so admirably are they fitted for life in the open water, are found upon examination to be only secondarily adapted to a pelagic life, like the sea-birds and the cetaceans.

Mr. Brooks bases these statements on evidence from paleontology, from embryology, and from the structure and habits of living animals.

In discussing the conditions under which the primitive pelagic fauna lived, and the comparative results of pelagic and bottom environment upon marine life, the author points out that while the animals which first settled on the bottom probably did not secure more food than did their floating allies, they obtained it with less effort and were able to devote their surplus energy to growth and multiplication. The rapid multiplication led to crowding and competition, prevented the influx of newcomers from the open water, and finally resulted in the elaboration and specialization of the types of structure already established. Evolution was rapid, for life at the bottom

introduced many and new opportunities for divergent modifications.

Another result was the escape of varieties from competition with their allies by flight from the crowded bottom to the open water above. The influence of these emigrants upon strictly pelagic forms is seen in the evolution at the surface of complicated forms like the siphonophores. But, on the whole, ocean space is so great and conditions of life in open water so easy that many of the pelagic organisms retain their primitive simplicity, existing simultaneously with the large and highly organized invaders from the shore and bottom.

The colonization of the bottom formed an important era in the evolution of marine life and the author devotes a section to a consideration of the characteristics of this primitive fauna of which the following is a summary:

"1. It was entirely animal, and it at first depended directly upon the pelagic food supply.

"2. It was established around elevated areas and in water deep enough to be beyond the influence of the shore.

"3. The great groups of metazoa were rapidly established from pelagic ancestors.

"4. There was a rapid increase in the size of the bottom animals and hard parts were quickly acquired.

"5. The bottom fauna soon produced development among pelagic animals.

"6. After the establishment of the bottom fauna, elaboration and differentiation among the representatives of each primitive type soon set in and led to the extinction of the connecting forms."

In comparing these characteristics with those of the earliest known fauna as sketched by Walcott, Mr. Brooks finds that in going backward toward the lower Cambrian he finds a closer and closer agreement with the biological conception of the primitive life at the bottom. And while he does not regard the Olenellan fauna as the first bottom fauna, since it contains forms secondarily adapted to pelagic life, such as pteropods, still, "a biologist must regard it as an unmistakable approximation to the primitive fauna of the bottom, beyond which

life was represented only by simple and minute pelagic organisms."

Mr. Brooks' point of view, then, is that marine life is older than terrestrial; it has shaped itself in relation to its food supply; this food supply, the microorganisms referred to above, is the only form of life which is independent and it therefore must be the oldest; from these simple types the pelagic ancestors of all the great groups of metazoa were slowly evolved until the colonization of the bottom, when a rapid advancement took place; the present highly differentiated forms which constitute the ocean fauna are the descendants of the colonizers, while the lower pelagic forms are the lineal representatives of the primitive forms, some of which are slightly modified by the influence of the emigrants from the shore and bottom.

RECENT BOOKS AND PAMPHLETS.

Abbott, W. L.—Notes on the Natural History of Aldabra, Assumption and Glorioso Islands, Indian Ocean. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the author.

Allen, J. A.—Description of a New Mouse from Lake Co., California.——Description of a new species of Geomys from Costa Rica. Extr. Bull. Am. Mus. Nat. Hist., Vol. V, 1893. From the author.

Ashmead, W. H.—Monograph of the North American Proctotrypidae. Bull. No. 45, U. S. Natl. Mus., 1893. From the Smithsonian Institution.

Ayres, H.—On the M. Flexor Accessorius of the Human and Feline Foot. Extr. Science, Sept., 1893. From the author.

Bache, R. M.—Reply to Mr. F. M. Thom's Specifications in opposition to the nomination of Mr. Bache for the Superindency of the Coast and Geodetic Survey. Phila., 1894. From the author.

Brazier, J.—Catalogue of the Marine Shells of Australia and Tasmania. Pt. III. Gasteropoda Murex. Sydney, 1893. From the Australian Museum.

Chapman, F. M.—On the Birds of the Island of Trinidad. Extr. Bull. Am. Mus. Nat. Hist., Vol. VI, 1894. From the author.

Claypole, E. J.—An Investigation of the Blood of Necturus and Cryptobranchus. Extr. Proceeds. Amer. Micros. Soc., Vol. XV, 1893. From the author.

Cook, O. F.—Notes on Myriapoda from Loanda, Africa, collected by Mr. Heli Chatelaine, including a description of a new genus and species. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

Dames, H. W.—Ueber das Vorkommen von Ichthyopterygian im Tithon *Argentinens.* Abruck. a. d. Zeitschr. d. Deutsch. geol. Gesell. Jahrg., 1893. From the author.

Eisen, G.—On California Eudrilidae. Extr. Mem. Cal. Acad. Sci., Vol. II, 1894. From the Academy.

Ellis, H.—Democracy in the Kitchen.——A Noviciate for Marriage. No date given.

Gill, T.—The proper Generic Name of the Tunnies. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI. From the author.

Harle, M.—Observations sur les Restes d'Eléphants du sud-ouest de la France. ——Sur la Succession des diverses faunes, à la fin du quaternaire, dans le sud-ouest de la France. Extrs. Compte rendu de la Soc. d'Hist. Nat. de Toulouse, 1893. From the author.

Janes, L. G.—The Brooklyn Ethical Association. Its Objects, History and Membership. Brooklyn, 1893. From the author.

Keyes, C. R.—Crustal Adjustment in the Upper Mississippi Valley. Extr. Bull. Geol. Soc. Am., Vol. 5, 1894. From the Society.

Lydekker, R.—On some Bird-bones from the Miocene of Grieve-St-Alban, France. Extr. Proceeds. Zool. Soc. London, June, 1893.

——On a Mammalian Incisor from the Wealden of Hastings. Extr. Quart. Journ. Geol. Soc., August, 1893. From the author.

Maps to accompany the Annual Report (new series) Vol. V, 1890-91. Geol. Surv. of Canada. From the Survey.

MERCER, H. C.—The Lenape Stone; or the Indian and the Mammoth. New York, 1885. From the author.

MERRILL, H. B.—The Structure and Affinites of *Bunops scutifrons* Birge. Extr. Trans. Wisc. Acad. Sci., IX. From the author.

MILLER, S. A. AND GURLEY, WM. F. E.—Descriptions of some new species of Invertebrates from the Paleozoic Rocks of Illinois and adjacent States. Bull. No. 3, Ill. State Mus. Nat. Hist., Springfield, Ill.. 1893. From the authors.

MITSUKURI, K.—On the Process of Gastrulation in Chelonia. Extr. Journ. Coll. Sci. Imp. Univ., Japan, 1893. From the anthor.

MORGAN, T. H.—Experimental Studies on Echinoderm Eggs. Abdruck aus Anat. Anz., IX, Bd., 1893. From the author.

MUYBRIDGE, E.—Descriptive Zoopraxography. Philadelphia, Pa., 1893. From the author.

NUTTING, C. C.—Report of Committee on Iowa Fauna.——Significance of the concealed Crests of Fly-Catchers.——President's Address. Extr. Proceeds. Iowa Acad. Sciences. No date given. From the author.

OSBORN, H.—Fruit and Forest Tree Insects. Extr. Report of the Iowa State Agric. Soc. 1892. From the author.

PACKARD, A. S.—Study of the Transformations and Anatomy of *Lagoa crispata*, a Bombycine Moth. Extr. Proceeds. Am. Phil. Soc., Vol. XXXII, 1893. From the author.

PENROSE, R. A. F., JR.—The Chemical Relation of Iron and Manganese in Sedimentary Rocks. Extr. Journ. Geol., Vol. I, 1893. From the author.

Proceedings of The International Congress of Prehistoric Archeology and Anthropology. 2d Session at Moscou, August, 1892. T. II, Moscou, 1893.

Proceedings Congrès International de Zoologie. Deuxième Session à Moscou Août, 1892. Moscou, 1893.

Records of the American Society of Naturalists. Vol. I, Pt. 11. Boston, 1894. From the Society.

Report of the Trustees of the Australian Museum for 1892. New South Wales, 1893. From the Museum.

RIBOT, TH.—The Diseases of Personality. Chicago, 1894. From the Open Court Pub.

RIDGWAY, R.—Catalogue of a Collection of Birds made in Alaska by Mr. C. H. Townsend during the cruise of the U. S. Fish Commission Steamer Albatross in 1888.

——Description of a New Geothlypis from Brownsville, Texas. Extr. Proceeds. U. S. Natl.. Mus., Vol. XVI. From the author.

RÖSE, C.—Contributions to the Histogeny and Histology of Bony and Dental Tissues. Extr. Dental Cosmos, Nov. and Dec., 1893. From the author.

ROTHPLETZ, A.—Ein Geologischer Querschnitt durch die Ost-Alpen nebst Anhang über die Sog. Glarner Doppelfalte. Stuttgart, 1894. From E. Schweizerbart'sche Verlagshandlung.

SCHIMKEWITSCH, W. M.—On the Pantopodes dredged off the west coast of Mexico, and in the Gulf of California, in charge of Alex. Agassiz, carried on by the U. S. Fish Com. steamer Albatross, during 1891. Extr. Bull. Mus. Comp. Zool. Harv. Coll., Vol. XXV, 1893. From the Museum.

Siebenrock, F.—Das Skelet von *Uroplates fimbriatus* Schneid. Separatabdruck aus Ann. des K. K. Naturh. Hofmus. Band VIII. Wien, 1893. From the author.

Stearns, R. E. C.—Notes on Recent Collections of North American Land, Fresh-water and Marine Shells received from the U. S. Dept. Agri. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

Stejneger, L.—Description of a new species of Blind Snake (*Typhlopidae*) from the Congo Free State.

——On some collections of Reptiles and Batrachians from East Africa and the adjacent Islands.

——Remarks on Japanese Quails. Extr. Proceeds U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

Tarr, R. S.—Notes on the Physical Geography of Texas. Extr. Proceeds. Phil. Acad. Sciences, 1893. From the author.

True, F. W.—Description of *Sitomys decolorus* from Central America.——On the Relationship of Taylor's Mouse *Sitomys taylorii*. Extrs. Proceeds. U. S. Nat. Mus., Vol. XVI. From the author.

Trumbull, M. M.—The Free trade in England. Open Court Pub. Company, Chicago, 1892. From the Pub. Co.

Wakeman, T. B.—Ernst Hæckel, His Works, Career and Prophecy. Evolution Series No. 2. New York, 1891. From the author.

Ward, L. F.—Status of the Mind Problem. No date given. From the author.

Williams, G. H.—The Distribution of Ancient Volcanic Rocks along the eastern border of North America. Extr. Journ. Geol., Vol. II, 1894. From the author.

Woodward, A. S.—The Evolution of Sharks' Teeth. Extr. Nat. Sci., Nov., 1892. From the author.

RECENT LITERATURE.

Gage's Microscope and Microscopical Methods.[1]—Some years ago we noticed one of the previous editions of this work, prepared for the use of the Students of Cornell University. The present, the fifth edition, is greatly enlarged and forms a most valuable guide to the microscope as an optical instrument, showing the use of each part, the means of testing and using it, correcting its faults, etc. Following this portion comes some more special directions for its use in spectroscopic and polariscopic work and in photography, together with a chapter on the mounting of slides in which every aspect of the subject, from the measuring of the thickeness of the cover glass to the labelling and storage of the slides is discussed, excepting that the staining and sectioning of the specimen is left for a second part which is announced as in preparation. This second part will deal with the use of the Microscope in Vertebrate Histology, and with the two volumes the student will not often meet with questions of technique in this line which cannot be answered by referring to this vade mecum. The work is well printed and is a credit to Comstock Publishing Company which issues it. It is well illustrated with 103 cuts while the fact that every other page is left blank, allows the student opportunity to add notes. The work will doubtless be used in many other laboratories than that for which it is especially preparared.

Shufeldt on Chapman's Birds of Trinidad.—To the Editors of The American Naturalist:

Dear Sirs:—In your issue for April, 1894, p. 332, I find a review of a paper by me on Trinidad birds in which, much to my surprise, the reviewer charges me with an attempt to place all but Passerine birds in the order Macrochires! I had intended in this paper to give the names of the sixteen orders which have representatives in the Trinidad avifauna, and under each order the families which most Ornithologists now believe to belong in it. In a vain endeavor, however, to hurry my paper through the press before sailing on a second voyage to Trinidad, the last half of the copy was unfortunately sent to the printer before the slips giving the names of orders and families had been

---

[1] The Microscope and Microscopical Methods by Simon Henry Gage. Ithaca, 1894, pp. viii, 165.—$1.50.

inserted. I did not see proof and the error was noticed too late for correction.

The fact that not only the names of orders but also those of *families* are wanting after "Macrochires" and "Trochilidæ," should, I think, have suggested to so practiced a reviewer that there was a *lapsus* somewhere.

It is certainly bad enough to be accused of trying to classify all but the Passeries in one order, but when it logically follows—and in this case it does—that one is also accused of attempting to crowd the same heterogeneous assemblage into the family Trochilidæ I must, in justice to myself, plead not guilty.

Very truly yours,
FRANK M. CHAPMAN.

American Museum Natural History, New York City. May 24, 1894.

Annual Report Minnesota Natural History Survey for 1892.[1]—The important papers incorporated with this report are as follows: The Geology of Kekequabic Lake with special reference to an augite-soda granite, by Mr. U. S. Grant; Report of a reconnoisance in northwestern Minnesota in 1892, J. E. Todd; and Field Observations of N. H. Winchell in 1892. A feature of general interest is a table of comparative nomenclature prepared by the State Geologist. This table gives the Minnesota Strata in order; the stratigraphy of the Wisconsin reports issued under the direction of Prof. Chamberlain; the terms used by the present Michigan survey; and the general terms used by the United States and Cananian geological surveys. These separate series are arranged so that one can see at a glance the supposed equivalents.

[1] The Geological and Natural History Survey of Minnesota. The Twenty-first Report, for the year 1892. N. H. Winchell, State Geologist. Minneapolis, 1893.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Schlosser on American Eocene Vertebrata in Switzerland.[1]—Dr. Max Schlosser has recently[1] reviewed the work of Prof. Rütimeyer of Basel on the "Eocene Fauna of Egerkingen." In this memoir Dr. Rütimeyer endeavored to show that there have been found on the Eocene bed of Egerkingen, Switzerland, certain genera of Mammalia which were previously discovered in North America, and had not been known from any part of Europe up to that time. These fossils he named as follows.

Tillodonta. *Calamodon europœus.*

Quadrumana. *Hyopsodus jurensis; Pelycodus helveticus.*

Condylarthra. *Phenacodus europœus; P. minor; Protogonia cartievii; Meniscodon pictetii.*

Dr. Schlosser makes the following critical observations on these species.

He considers the *Calamodon*[2] *europœus* to be well established.

Hyopsodus jurensis is probably an Artiodactyle allied to Dichobune. The *Pelycodus helveticus* is a lemuroid, but of a genus different from Pelycodus. *Phenacodus minor* is probably a Creodont, while the *P. europeus*, *Protogonia cartierii* and *Meniscodon pictetii*, Dr. Schlosser thinks belong to a single genus, which he thinks is Protogonia (Euprotogonia). He doubts whether the teeth, on which the three species are founded, belong to distinct species.

As a result Schlosser concluded that Rütimeyer in correct in determining the American genera Calamodon (Conicodon) and Protogonia, (Euprotogonia) as occurring in the Egerkingen formation. The lemuroids and creodont are of types common to both continents, while the Dichobunid is European in relationship.

Schlosser further remarks, that a boreal fauna, such as exists at present, was unknown during the Cenozoic ages. Europe was the home

---

[1] Zoölogischer Anseiger, 1894, no. 446, p. 157.

[2] A genus of birds has been named Calamodus, a name which is in my opinion abundantly distinct from Calamodon. As, however, there are persons who, like the American Ornithologists Union, will make this resemblance an excuse for changing the name, I suggest that they call it Conicodon, from the shape of the molars, as distinguished from those of Stylinodon.

of the Artiodactyla except Oreodontidæ and Tylopoda, of the true Carnivora, and the Monkeys (except the S. American). North America was the home of the Perissodactyla and Amblypoda, and the ancestors of the monkeys and carnivora, during that time.

The Skull of Pisodus owenii.—It is now a well-established fact that many types of Teleostomous fishes have undergone very little change since the Eocene, or even since the latter part of the Cretaceous period. Several well-defined genera seem to date back thus far, and others are represented by forms that differ in but small particulars. Moreover, a few of the most remarkable specializations in piscine skeletal anatomy chatacterizing the existing fauna are already recognizable in certain closely related Eocene types, and the progress of discovery is continually adding to the number of known examples. A most striking new case has been lately met with by the present writer among the fishes from the London Clay (Lower Eocene), and this forms the subject of the following notes.

So long ago as 1845, Sir Richard Owen described and figured the tritural dentition of an unknown fish form the London Clay of the Isle of Sheppey under the name of *Pisodus oweni* (ex. Agassiz MS.). The original specimen is preserved in the Museum of the Royal College of Surgeons, and exhibits an ovate pavement of small rounded or polygonal teeth firmly fixed in shallow sockets upon a plate of true bone. Appearances suggested to Sir Richard Owen that the fossil had been attached to another bone of the skull, most probably, as in Glossodus and Sudis, to a median bone of the hyoid system. Agassiz, who first examined the specimen, supposed it might pertain to a so-called Pycnodont Ganoid; and in Owen's Paleontology (edit. 2, 1861, p. 174) Pisodus is also doubtfully quoted as a "Ganoid" of uncertain position.

It now appears from a nearly complete skull in the British Museum that the problematical fossil in question is the parasphenoid dentition of a fish remarkably similar in cranial characters to the recent Clupeoid Albula. The fact has already been incidentally mentioned in a record of the discovery of Pisodus in the Middle Eocene of Beligium; and it only remains to justify, by a detailed description and figures, the recognition of an Albula-like fish at so remote a period as that of the Lower Eocene. Dr. Shufeldt's admirable description of the skull of the recent *Albula vulpes* fortunately suffices for requisite comparison. (Dr. Smith Woodward in Ann. Mag. Nat. Hist. Ser. 6, Vol. XI, 1893.)

Geological News, Cenozoic.—In studying the origin of Lake Cayuga, Mr. R. S. Tarr, has become a convert to the rock-basin theory of lake formation. In a paper recently published he shows that the preglacial tributaries to the Cayuga valley are rock enclosed and that their lowest points are above the present lake surface. This the author holds to be proof positive that Lake Cayuga is a rock-basin. If this be true, a similar course of reasoning would suggest that Lake Ontario is also a rock-basin, from the fact that the preglacial Cayuga River flowed north and was tributary to a river which drained Ontario, and whose channel was above the present surface of the lake. (Bull. Geol. Soc. Am., Vol. 5, 1894.)

The recognition of the extension of the Pine Barren flora of New Jersey through Staten Island, Long Island, Nantucket, Southern Rhode Island, and Massachusetts, suggests to Mr. Arthur Hollick a theory of a continued existence of land connection between New Jersey and southeastern New England, by way of Long Island, during a sufficient time after the final recession of the glacier, for the pine barren flora to have spread and become established there. This theory would seem to be supported by the position and configuration of the chain of islands to the east of Long Island Sound, and by the geological history of this region. If Mr. Hollick's views are correct Long Island, Block Island, Nantucket, Martha's Vineyard, etc., as we now know them, have not been snbmerged since the final retreat of the glacier, and their separation into islands is a comparatively modern phenomenon due to erosion, and the depression of the costal plain. (Taans. New York, Acad. Sci. Vol., XII, 1893.)

A new theory of the origin of Drumlins has been advanced by Mr. Warren Upham, viz.; they are the result of the accumulation of englacial drift. The author offers the following explanation of the manner of the accumulation. The upper current of the thickened ice above the englacial bed of drift would move faster than the drift, which in like manner would outstrip the lower current of the ice in contact with the ground. Close to the glacial boundary the upper ice must have descended over the lower part. This differential and shearing movement gathered the stratum of englacial drift into the great lenticular masses or sometimes longer ridges of the drumlins, thinly underlain by ice and over-ridden by the upper ice flowing downward to the boundary and bringing with it the formerly higher part of the drift stratum to be added to these growing drift accumulations. The courses of the glacial currents are not determined by the topography of the underlying land, but by the contour of the ice surface. (Proceeds. Boston, Soc. Nat. Hist., Vol. XXVI, 1893.)

MINERALOGY.[1]

Contributions to Swedish Mineralogy, Part I:—In this paper Sjögren[2] has given in English a very interesting series of crystallographical studies. The well known but rare axinite from Nordmarken is reexamined. In addition to the tabular crystals described by Hisinger and v. Rath's prismatic type, a third type of smaller crystals is identified having neither the tabular nor the prismatic habits and highly modified. Hedyphane which is closely related chemically to the members of the apatite group, particularly mimetite, has been supposed to possess monoclinic symmetry on the basis of Des Cloiseaux's determination in 1881. Sjögren has examined crystals from the Harstigen mine in Wermland and finds that both crystallographically and optically hedyphane is hexagonal. The crystals examined exhibited the forms oP, ∞ P, P, $\frac{1}{2}$P, 2P, P2, 2P2, and clearly belong to the apatite group. Another member of the apatite group is discovered in Sjögren's new mineral svabite, which occurs in schefferite at the Harstigen mine. Svabite is a hydrous calcium arsenate of the composition indicated by the formula $HO\,Ca_5\,As_3\,O_{12}$ in which the hydroxyl appears to be part replaced by chlorine and fluorine. The mineral is crystallographically like apatite and exhibits the forms ∞ P, P, P2, oP. The same mineral was found at Jacobsberg, enclosed in hausmannite. A very exhaustive study is made of the minerals of the humite group, all of which are found at Nordmarken. No less than 29 forms were observed on chondrodite from this locality, and these include the six new forms, $+\frac{1}{2}P$,$-\frac{1}{5}P$,$+\frac{1}{5}P$,$-\frac{3}{7}\bar{P}\frac{3}{2}$,$+\bar{P}2$,$-\frac{3}{11}\bar{P}\frac{3}{2}$. The humite of the locality showed 20 and the clinohumite 26 forms, all of which have been observed on Vesuvian crystals. A probable fourth member of the humite group which occurs at Nordmarken, is announced in this paper. Three new analyses of longbanite are contributed, on the basis of which the formula of the mineral is given as $m\,Sb_2O_3\;n\,Fe_2\,O_3\,p\;R^{IV}R^{II}O_3$ in which R^{IV}=Mn and Si, and R^{II}=Mn, Ca, and Mg. The symmetry of the mineral is shown to be rhombohedral, this and the chemical constitution indicating its isomorphous relation with hematite and ilmenite. Adelite is the name given to a new basic arseniate from Nordmarken, Jacobsberg and Longban, having the for-

---

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Bull. of the Geol. Inst. of Upsala, I; No. 1, (1892), pp. 1–64, pls. I–IV.

mula $2CaO, 2MgO, H_2O, As_2O_5$. The symmetry of the mineral is monoclinic and its relationships, both chemical and crystallographical, are with triploidite, wagnerite and sarkinite.

Optical Methods :—Friedel[3] has devised a new method for determining the double refraction in thin sections of minerals on the stage of the ordinary petrographical microscope. The method makes use of the quarter undulation mica plate. The nicols are crossed and the slide is raised a short distance above the stage on thin blocks, so as to allow of the introduction of the mica plate between the slide and the stage. The stage is now revolved until the directions of extinction make 45° with the principal sections of the nicols. The mica plate is introduced below the slide and carefully turned without moving the stage until that portion lying outside the mineral plate is extinguished. By now revolving the polarizer, the mineral can be extinguished or given the same illumination as the mica plate. The observations are made in monochromatic light. If the positive direction of the mineral plate passes through the upper right quadrant of the field and the positive direction of the mica plate coincides with the vertical cross hair, the polarizer should be revolved to the right, the angle φ required to produce extinction, and the angle φ_1 required to produce equal illumination of mineral plate and mica plate, yielding ψ the difference in phase produced in the mineral section. The formulas are $\psi = \varphi_1$ and $\psi = 2\varphi_1$. The greater part of the paper is devoted to methods of evaluating errors in the process.

Harker[4] has determined trigonometrically the values of the extinction angle in prismatic cleavage flakes of augite and hornblende, as dependent on the optical angle and the extinction angle in the plane of symmetry. His tables of values will be convenient for reference, but as he points out, the variation in the values with 2V is not great enough to determine the optical angle from measurements of the prismatic and clinopinacoidal extinction angles.

Isotypism :—Rinne[5] compares crystals of the metals with crystals of their oxides, sulphides, hydroxides and haloid compounds. He points out that in this comparison we find strikingly close relationships between bodies markedly different chemically, and these relationships do not consist simply in identity of crystal symmetry, but in

---

[3] Bull. Soc. Franç. Minér., XVI; 19 (1893).

[4] Min. Mag., X (No. 47), p. 239.

[5] Neues Jahrb. f. Min., etc., 1894, (I) pp. 1–55.

close approximation to a type as regards crystal shape (Krystallgestalt) and interfacial angles. Even when the symmetry of two substances is not identical, he makes comparison of the crystal shape as, e. g., between a cube and a rhombohedron with polar edge approaching 90°. The author distinguishes seven types as follows: I regular type (isometric), II magnesium type (hexagonal and pseudo-hexagonal—orthorhombic), III arsenic type (rhombohedral), IV quartz type (hexagonal tetartohedral), V $\overset{\frown}{a}$ tin type (tetragonal), VI rutile type (tetragonal and pseudo-tetragonal—orthorhombic), VII β tin type (orthorhombic and pseudo-orthorhombic—monoclinic). Every group but the fourth contains metals and this type Rinne considers as derivable from the third or arsenic type. Many oxides, etc., have their crystal forms to some extent indicated in the forms of their contained metals. The term isotypism is proposed to describe these crystallographical relations between members of different divisions of the chemical mineral system. The author further states, "It must now be accepted as a fact that such substances" (elements, oxides, sulphides, haloid salts, and even silicates, which have been grouped together under his various types) "possess equivalent or very similar crystal forms, and it follows that the chemical differentiation into elements, oxides, salts, etc., finds no crystallographical expression, and therefore no independent, certain conclusion as to the chemical group to which a compound belongs can be drawn from its crystal form."

Lamellar Structure in Quartz Crystals.—In an "additional note on the lamellar structure of quartz crystals and the methods by which it is developed," Professor Judd[6] describes and figures a remarkably beautiful instance of lamellar structure in quartz, in which he sees a close analogy with the "rippled fracture" which he finds can be produced in quartz crystals by breaking them in a powerful vice along a plane perpendicular to the optic axis. The appearance of such fractures is very much like that of "engine-turned surfaces." This appearance is caused by ridges following the planes R and −R, which are often curved and die out in the manner of plagioclase lamellæ. From a study of the lamellæ in an equatorial section of quartz supposed to be one of those investigated by Brewster, Professor Judd concludes that quartz is dimorphous. What he calls "stable quartz" shows no tendency to assume a lamellar structure, whereas "unstable quartz" constantly exhibits such a tendency. The latter variety is usually amethystine. The lamellæ consist of alternating bands of

---

[7] Min. Mag., X, p. 123.

right and left handed quartz. When they are bent or disturbed they furnish biaxial interference figures. Many crystals are composed of both stable and unstable quartz, the relative positions of which show some relation to the symmetry of the crystal. Such crystals, or crystals composed entirely of unstable quartz, have the lamellæ induced by great mechanical stresses. The fact that the structure is only faintly induced and that very near the fracture in artificially crushed crystals, is explained by the short time during which the stress is applied, permanent structure being produced only after a long application of the stress.

PETROGRAPY.[1]

Contact Effects around Saxon Granites.—The effects of the granite and syenite of Lausitz, of the granitite of Markersbach and of the tourmaline granite of Gottleube upon the rocks through which they cut in the Elbthalgebirge in Saxony, are concisely described by Beck.[2] The members of the phyllite formation and the beds of Cambrian, Silurian and Devonian age, whatever may have been their nature, have all undergone contact metamorphisen near ther junction with the eruptives. During the process of alteration there seems to have been little addition of material to the metamorphosed rocks, as all the contact products when originating from the same member of the bedded series are the same, irrespective of the nature of the metamorphising eruptive. The great variety in the contact products of the region is due solely to differences in the character of the originals of the altered rocks. The phyllites have been changed to 'Fruchtshiefer' and into andalusite mica schists, chlorite gneisses into biotite gneiss, and feldspathic quartzites into hornfels. The Silurian slates near the contacts have become hornstones and knotty schists, carbonaceous quartz schists have changed into graphitic quartzites, graywackes and marbles have been made crystalline, and the latter rock has in many cases been changed into a calc-silicate aggregate, which has been impregnated with ore masses, presumably originally in the granitite with which the limestones were in contact. Diabases and diabase tuffs in proximity to the intrusive rocks have been amphibolized. The Devonian rocks have suffered the same alterations as the corresponding Silurian ones, and in addition there has been formed a gneiss-like rock whose predecessor among the clastics is unknown. A large number of contact minerals are discussed at length by the author, chief among them being quartz, plagioclase, cardierite and graphite. The article is full of instructive suggestions though nothing of striking novelty is met with in it.

The Schists of the Malvern Hills.—Callaway[3] has published a final summary of the conclusions based on seven years work in the Malvern Hills. He reiterates his belief that the schists of the region

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Min. u. Petrog. Mitth. XIII, p. 290.

[3] Quart. Jour. Geol. Soc., XLIX, p. 398.

are squeezed eruptives, and discusses the physical, mineralogical and chemical changes that have effected the alteration of the granites and diorites into gneisses and schists of various kinds. His conclusion that a sericite schist may be derived from diorite and that biotite is often an alteration product of chlorite are both of great interest. In the change of a massive into a schistise rock, the author states that the former "passes through the intermediate state of a laminated grit, which thus simulates a true sediment, the subsequent stages of alteration and cementation resembling the process of metamorphism in some bedded rocks." In the production of the foliation there is decomposition of the original components of the massive rock and a reconstruction of new minerals largely from these decomposition products. In the Malvern Hill rocks orthoclase has been replaced by quartz and muscovite, plagioclase by quartz and muscovite, chlorite by biotite and white mica, and biotite by a white mica. A number of analyses appear in the paper to illustrate the chemical changes that have accompanied the physical ones through which the respective rocks have passed.

A Soda-Rhyolite from the Berkeley Hills, Cal.—In the Contra Costa Hills near Berkeley, California, are occurrences of a volcanic flow that has been investigated by Palache,[4] who recognizes three facies of the rock. In the first, the porphyritic phase, phenocrysts of quartz and feldspar are abundantly disseminated through a micro-grauular aggregate of the same minerals. The second phase is characterized by the possession of numerous small spherulites in a glassy matrix, in which are a few small grains of magnetite and some feathery aggregates of chalcedony. The third phase is a glass containing tiny microlites of feldspar and grains of magnetite. Analyses of the different types indicate that the material of each type has the composition of a soda-rhyolite. The spherulitic variety which is intermediate between the other two, in its acidity is composed as follows:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	Total	Density
75.46	13.18	.91	.95	.10	1.09	6.88	.93	=99.50	2.42

Diabases from Rio Janeiro, Brazil.—Sections from a series of twelve diabase dykes from Rio Janeiro, Brazil, have been investigated by Hovey,[5] with some interesting results. The chemical composition

---

[4] Bull. Dept. Geol. Univ. Cal., Vol. 1, p. 61.

[5] Min. u. Petrog, Mitth. XIII, p. 211.

of all the dykes is practically the same. Their mineral composition and structure, however, vary. In the largest dykes the number of constituents discovered is much greater than in the smaller ones. They embrace the usual diabase components with the addition of a light colored sahlitic pyroxene differing from the sahlite of Sala in the value of its optical angle. In the Brazil mineral $E_a=32° 39'$, while in the Sala mineral it is $112° 30'$. It is the oldest constituent of the rock after magnetite, and, consequently it is that which approaches most nearly to being idiomorphic. The structure of the large dykes is gabbroitic and ophitic, whereas that of the small ones is porphyritic and hyalopilitic, with the pyroxene figuring as the phenocrysts. Quartz is not uncommon in the coarser rocks and granophyric intergrowths of quartz and feldspar are frequently met with.

The New Island off Pantelleria—A Correction.—In these notes for December[6] last, the statement was made concerning the material of a recent eruption near Pantelleria, that it consisted of loose blocks and of lava. Mr. G. W. Butler of Chertsey, England, corrects this statement in a recent letter to the writer and declares that the new island formed during the eruption was composed entirely of loose scoriaceous bombs, which disappeared a short time after the eruption ceased.[7]

Petrographical Provinces.—Iddings[8] gives a brief and, consequently, a tantalizing account of the old volcano of Crandall Basin in the Absaranka Range of Mountains in the Yellowstone National Park, that has been eroded in a manner to give a good section of the cone with the dykes and flows radiating from it. The different rock types mentioned in the paper are simply alluded to, a full account of them being promised later. The author's conclusion from his study is to the effect that we have here proof that the texture of rocks and their mineral composition is more directly dependent upon the rapidity with which the rocks cooled, than upon the pressure to which they were subjected during their solidification. The differentiation of rock magmas is also well shown in the case of the volcano studied by the production of many individual rock types.

Upon comparing thirty-nine of the best analyses of rocks occurring in the eruptive areas around the Bay of Naples, Lang[9] concludes that

---

[6] AMERICAN NATURALIST, Dec., 1893, p. 1088.

[7] Cf. also G. W. Butler; *Nature*, April 21, 1892.

[8] Jour. Geol., Vol. 1, p. 606.

[9] Zeits. d. deutsch. geol. Ges. XLV, p. 177.

there are here three independent volcanic centers, represented respectively by Ischia, Vesuvius and Mt. Nuovo. That they are on different volcanic fissures is indicated by the differences in the character of the lavas extruded from them, especially in their sodium and calcium contents. At each center each magma became differentiated, and this differentiation explains the variety of the rock types discovered in each.

'A study in the consanguinity of eruptive rocks' is the title of an article by Derby[10] in which is shown the fact that the occurrence of the eleolite syenites, phonolites, monchiquites and other related rocks in Brazil, point to the correctness of the notions of differentiation and consanguinity as explanatory of the existence of different phases of eruptive rocks within the same volcanic sphere. The author also shows that, while not having formulated the theory, its principle has been the guide in his work on the Brazilian rocks.

Miscellaneous.—Upon examining spherulites of lithium phosphate between crossed nicols, McMahon[11] finds that some of the groupings present apparently miaxial crosses which remain fixed in position during a complete revolution, while in others the cross breaks up into two hyperbolic branches resembling those of biaxial optical figures. The phenomenon, the author regards as due to molecular strains that affected the spherulites at the time of their crystallization.

[10] Jour. Geol., Vol. 1, p. 579.

[11] Mineralogical Magazine, X, p. 229.

BOTANY.[1]

Thaxter's Studies of the Laboulbeniaceæ.—Mr. Thaxter has recently issued the fifth of his preliminary papers upon the *Laboulbeniaceæ* preparatory to the monograph of that group upon which he is engaged. In this paper he describes four new genera and fourteen new species, and gives a synopsis of the described species of the group. As it is indicated that the paper in question is to be the last of his preliminary papers, a few words as to his work upon the group and the effect which it seems likely to have may be timely.

Although the first representatives of the family were noticed as early as 1853, and received their first systematic treatment in 1869, it is only within a short time that the group has been thoroughly studied and any great number of forms discovered. In fact the great majority of the forms have been found in this country by Mr. Thaxter. In the first of his preliminary papers, in 1890, Mr. Thaxter states the total number of described species at fifteen. In the present paper he enumerates in the course of his synopsis twenty-three genera and one hundred and twenty-two species. The difference is mostly due to his researches.

The *Laboulbeniaceæ* are parasites on the outer surfaces of insects, principally of insects which live in or about the water. They grow either singly or in a thick fur, and are very minute, the largest not exceeding 1 mm., and most species being about 0.5 mm. in length. They have no mycelium and consist solely of a short stalk and a reproductive apparatus.

Reproduction in these fungi is of one sort only. Karsten was the first to describe it and he compared it to the sexual reproduction in the *Florideæ*. Peyritsch afterward made more exact and extensive observations and came to the conclusion that the supposed abscission of spermatia did not take place and that the sexual nature of the process was doubtful. Since these observations little or nothing has been published on the subject and for that reason the following statement made in the present article is of great interest:

"The writer's observations, based upon an examination of several thousand specimens illustrating more than one hundred species and

---

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

more than twenty genera, appear to warrant the following conclusions."

"The *Laboulbeniaceæ*, while showing no signs of any non-sexual mode of reproduction are characterized by a well marked sexual type closely resembling that of the simpler *Florideæ*."

He goes on to give a summary of the process, which cannot well be abbreviated, and which is too long to be repeated in this place. Suffice it to say that he has found that "the trichogyne varies from a simple vescicular receptive prominence, or short filament, to a copiously branched and highly developed organ," that, however highly it may be developed, it always disappears immediately after fertilization; that the antherozoids are non-motile spherical or rod like masses of naked protoplasm, which originate in two genera exogenously from special branches and in other genera are produced endogenously in antheridia; that the antheridia are either single specialized cells or highly developed multicellular bodies, from which in either case the antherozoids are discharged through a terminal pore. It appears also that while the sexes are commonly present in the same individual, in some species they are completely separated on specialized individuals.

Although the observations, on which the foregoing conclusions are based, are not given, we may take it to be settled that the doubts as to the nature of the reproduction in these fungi raised by the observations of Peyritsch are set at rest. If so, several interesting questions arise.

There seems to be no doubt, as Mr. Thaxter remarked in a prior paper, that these fungi are real *Ascomycetes*. Indeed their title to a place in that group seems much better than that of some others which are included with little hesitation. If they are *Ascomycetes*, the ghost of the much vexed question of sexual reproduction in that group, which it was supposed had been effectually laid by Brefeld, must soon begin anew its visitations. And in any case, since the relationship of the *Laboulbeniaceæ* to the *Ascomycetes* as a whole must be close, even though they have no apparent relationship to any particular group of them, the whole scheme of the relationship of the *Ascomycetes* framed by Brefeld and his followers is placed on very shaky ground by the conclusions which Mr. Thaxter has announced.

After it had been shown that there was no sexual process in the *Ascomycetes*, the question remained, to what fruiting stage of the simpler fungi does the ascus stage of the *Ascomycetes* correspond. Brefeld has answered this by comparing it with the sporangium fructification of the *Mucoraceæ*. The ordinary *Ascomycetes*, called *Carpoasci*, he derives

through *Thelobolus* from the carposporangic *Zygomycetes*, as *Mortierella*.

But the fact that in the *Laboulbeniaceæ* an ascus fructification is produced as the result of a sexual process throws grave doubt upon this theory, if it does not wholly overthrow it. It seems clear that the process of reproduction in these fungi, as outlined by Mr. Thaxter, indicates that the comparison of the ascus to the sporangium of the *Mucoraceæ* is wholly erroneous and that DeBary was right in considering it homologous to the sexual fructification of the *Phycomycetes*, whether or not he was wrong in believing it to be in many cases the result of a sexual process. It is perhaps not without significance that works like Von Tavel's Morphologie do not notice the *Laboulbeniaceæ* at all.

Another and still more interesting question will be presented when some one in the light of the development of the *Laboulbeniaceæ* ventures to reopen the question of the formation of the spore-fruit in the *Ascomycetes* and to question the conclusions of Brefeld. That the evidence must be reexamined seems to be clear if the conclusions announced by Mr. Thaxter are sustained by his observations. We have come to regard all accounts of sexual processes in fungi as doubtful since the writings of Brefeld have produced a school of sceptics on such points. If in a group which must be admitted to be immediately related to the *Ascomycetes*, if not a veritable member of them, which it evidently is, antheridia, antherozoids, and trichogynes—terms which the works on the morphology of the fungi have agreed to discard for the higher fungi—actually occur, we cannot rest content with any explanation of the formation of the sporocarp in the *Ascomycetes* which leaves any phenomenon apparently connected with those found in the *Laboulbeniaceæ* unaccounted for.

Mr. Thaxter's brief sketch suggests many coincidences which serve to convince one that the ghost of the DeBaryan theory as to the *Ascomycetes* will not down and that we may expect it to visit our slumbers nightly until we find some better means of reconciling the *Laboulbeniaceæ* with current theories as to the *Ascomycetes* than at present seems possible.

Mr. Thaxter's forthcoming monograph will be awaited eagerly by all who are in any degree interested in the morphology and biology of the fungi. It goes without saying that his previous work is a guaranty that our expectations will be amply realized.

Roscoe Pound.

ZOOLOGY.

The Antennal Sense Organs of Insects.[1]—During his studies carried on in Leuckart's laboratory on the peculiar sense organ in the the base of the antenna of certain Diptera (*Mochlonyx culiciformis*, *Corethra plumicornis*), Mr. C. M. Child found that the organ occurs generally in Diptera, and, if not generally, at least very often in the other orders of Insects.

In the wasp (*Vespa vulgaris*) the organ occurs in the second joint of antenna. Near the end of the first joint the main nerve of the antenna gives off branches on all sides. These run toward the periphery of the second joint, connecting with ganglion cells, which in turn connect with small rod-like bodies that end in the articular membrane between the second and third joints. These rods are gathered into groups each of which ends in a pore in the membrane. On the outside of the antenna no sense hairs are found corresponding to these pores, which seem to be closed on the outside. Between the rods nuclear elements were found, but whether they were of connective tissue or of nerve elements was not determined. An organ similarly placed and of similar structure is to be found in the genera: *Melolontha* (*Coleoptera*), *Epinephele* (*Lepidoptera*), *Bombus* (Hymenoptera), *Pachyrhina*, *Tabanus*, *Syrphus*, *Helophilus*, *Musca*, *Sarcophaga* (Diptera) *Sialis*, *Panorpa*, and *Phryganea* (Neuroptera), *Libellula* (Pseudoneuroptera.)

Of the Hemiptera only the Homoptera were investigated. Here the rods and ganglion cells are fewer in number. *Periplaneta*, *Locusta* and *Stenobothrus* among Orthopteran genera have a structure in the second antennal joint with ganglion cells and long fibrous rods. Thysanura were not studied.

In certain Diptera (Culicidæ and Chironomidæ) the organ is somewhat different. At the base of the antenna of both sexes there is a nearly spherical joint. This is larger in the male than in the female. In the latter the nervous structure within this joint is much more readily comparable to the organ described for the wasp than that in the male. But even in the male the structure may be reduced to the general type. In the female the rods instead of ending at the periphery of the second joint are directed toward the middle of the long feeler. The large antennal nerve runs chiefly to the ganglion cells, giving off two small branches that run on into the other joints of the antenna. There is no

---

[1] Zool. Anz. XVII, p. 35, 1894.

sharp line to be drawn between the ganglion cells of the organ and the brain. The rods are delicate and covered with small nuclei very well supplied with chromatin.

To what has already been made known by Weismann and Hurst on the general development of the antenna in these insects, Mr. Child adds that the entire sense organ is formed from a fold at the base of the invaginated hypodermal cavity, and that the differentiation of the rods and ganglion cells takes place very early.

The organ he considers to be auditory in function, agreeing with Johnston, Mayer and Hurst.[3] Supporting this view is the fact that the rods are so placed as to be affected by any slight motion imparted to the distal part of the antenna, either by sound waves or otherwise. It has been repeatedly shown by others that certain insects seem to hear by means of their antennæ. To offset the fact that the so-called tympanum of certain Orthoptera is considered to be auditory he recalls the experiments by Graber, who found that insects in which the tympanum had been destroyed still reacted to sound waves which affected the antennæ or in some cases the legs. The organ is of further interest in that there is shown in it no marked difference between hearing and touch.—F. C. KENYON.

The Luminous Organs of Histioteuthis rueppellii Verany.—Dr. Joubin has recently been making a study of the luminous organs of a rare cephalopod, *Histioteuthis rueppellii*, found near Nice. The animal belongs to the abyssal fauna and the specimen in question is over a meter in length. The author describes the outward appearance of its phosphorescent organ, and its internal organization, comprising a reflector, which the author calls a mirror and an apparatus for producing light. Mr. Jourbin offers the following theory of the use of the luminous organ to the animal.

" Ordinarly the light-producing apparatus does not function. It is like a machine at rest. But if a living creature suitable for food wanders into the vicinity of the cephalopod, this prey being of a higher temperature than the water in which it floats emits caloric radiations. These heat rays impinge on the reflecting mirror and are then concen-

---

[3] Johnston.—Auditory Apparatus of the Culex Mosquito. Journ. Micr. Sci. III, old series.

Mayer.—Researches in acoustics. Am. Journ. Sc. Series III, vol. 8.

Hurst.—The Pupal Stage of *Culex*, Inaug.-Diss. Leipzig, 1890.—On the Life History and Development of a gnat. Trans. Manchester, Micro. Soc., 1890. The Post-embryonic Development of Culex. Proc. Liverpool Biol. Soc. IV.

trated in the light-producing apparatus, causing there a sensation, and the organ functions by reflex action. The surrounding medium is then illuminated by rays perceptible by the eye of the animal. In a word, these organs are the organs of a caloric sense. Heat sensations are the only kind that can be felt in those abysses when the darkness is relieved by occasional gleams of phosphorescent light. I add, finally, that I have found in another cephalopod an extremely curious organ constructed in such a manner that it does not perceive light rays, but can only receive heat rays, which confirms the hypothesis just advanced," (Bull. Soc. Sci. et Med. de l'Ouest France, t. II, no. 1893.)

Verrill's Organ.—In the funnel of certain Cephalopods, several authors have noticed a peculiar cushion-like organ, situated a little behind the valve, and this has, for very insufficient reasons, been called Verrill's Organ by Hoyle and others. Its function and homology have been the subject of some discussion. Ferussac and D'Orbigny confused it with a transverse muscle; H. Müller, in 1852, thought it was a stinging organ; Verrill, in 1882, considered it "the true homologue of the foot of gasteropods;" Laurie, in 1888, from rather insufficient material, showed its glandular nature, and believed that it secreted mucus, but his observations were criticised by Brock; Hoyle, in 1889, believed that it served to close the funnel. That it is really a mucous gland is now proved by the careful observations of G. Jatta (Boll. Soc. Nat. in Napoli, vol. VII, p. 45, 1893), who has observed it in 32 species belonging to 21 genera, thus bringing the number of genera in which it has been found from 10 to 27. He describes and figures six main modifications of its arrangement, and gives excellent drawings to show its microscopic structure in different stages of its development. He concludes that this funnel organ is a mucous gland homologous with the pedal glands of other mollusca. If this be so, the organ must be somewhat archaic, and one would expect to find it in *Nautilus*, where, to the best of our knowledge it has never been described. (Nat. Sci., Feb., 1894.)

Preliminary Descriptions of Some New South American Characinidæ.—1. *Tetragonopterus heterorhabdus.* This species is related to *T. schmardæ* Steindachner. It is readily distinguished from *T. schmardæ* by the conspicuous dark lateral band which has on the anterior end an oval expansion resembling the humeral spot present in in many species of *Tetragonopterus.*

D. 10 ; A. 20–23 ; head 3⅓ ; depth 3½, eye in the head 2½ and once in the inter-orbital ; scales 32–34, the lateral line incomplete, only 6 scales perforated.

Maxillary toothless, extending nearly to the centre of the pupil of the eye. The dark-brown lateral band, deepest colored anteriorly, edged above with a conspicuous silvery band. No caudal spot. Dorsal about midway between the tip of the snout and base of the caudal, and over the space between the anal and ventral. Anal with first six rays elongate. Many specimens from Brazil. Length 10–29 mm.

2. *Tetragonopterus paucidens.* Related to *T. diaphanus* Cope from which it differs in having 1 to 3 maxillary teeth ; in proportions and in lateral markings.

Head 3½ ; depth 2¾, in the length. Snout 3½, diameter of the eye 3 in the head. The maxillary extends to the anterior border of the pupil. A silvery lateral band and a diffuse caudal spot present. No humeral spot.

D. 11 ; A. 19 ; scales 5–31–3 ; lateral line complete. Length 45 mm.

One specimen from Itaituba, 45 mm. long.

3. *Tetragonopterus santaremensis.* This species has much the appearance of *T. bellottii* Steindachner. The scales of the lateral line are perforated to the base of the caudal while in *T. bellottii* only 5 to 7 scales are perforated. The caudal spot is somewhat more rhomboidal and extends to the end of some of the rays, otherwise the lateral band and humeral spot are about as in *T. bellottii.*

Head 3⅓ ; depth 3¼ in the body. D. 10 ; A. 20–22 ; scales 5–30–3. Anterior dorsal and anal rays elongate. Snout short, 4 in the head. Maxillary toothless, extends to the eye. Diameter of the eye somewhat more than the width of the inter-orbital and 2½ in the head.

Ten specimens from Santarem, 8–24 mm. long.

4. *Tetragonopterus astictus.* Related to *T. humilis* Günther. It differs from that species in having no caudal or humeral spot, no red margins on the anal and ventral fins and fewer rows of scales.

Head 3½, depth 3½, in the length. Eye 2½ in the head and once in the inter-orbital space. A silvery lateral band present, most distinct posteriorly.

Lateral line complete, scales 5–35–3½. D. 10 ; A. 30. Maxillary toothless, extending a little past the anterior margin of the orbit.

One specimen 53 mm. long from Brazil.

5. *Aphyocarax maxillaris.* Maxillary with minute teeth along its entire margin. Intermaxillary with about ten teeth, the inner four three-pointed. Mandible with a few conical teeth in front.

Depth 3–3⅓; head 3½. D. 11; A. 22–23 scales; 30, tubes 6. Snout very short, the maxillary extending beyond the anterior margin of the eye.

A small circular humeral spot present, sometimes reduced to two or three color cells. A large black spot on the upper half of the first dorsal rays, the tips of these rays white. A small black spot near the tip of the first fur and rays.

A. agassizi Steind. differs from *A. maxillaris* mainly in its larger number of anal rays. Brazil, 10 specimens, 10–11 mm. long.

6. *Aphyocarax heteresthes.* Maxillary teeth six, conical. Intermaxillary with eight conical teeth and two with lateral cusps on each side. This species is related to *A. agassizii* Steindachner and *A. eques* Steindachner. From the former it differs in having only the upper part of the maxillary dentiferous and apparently in having the anal rays graduated. From the latter it differs chiefly in having no humeral spot.

Depth 3; head 3⅓. D. 11; A. 27–30; scales about 31. Snout very short, maxillary long, extending considerably beyond the anterior margin of the eye. Eye twice the length of the snout, ⅖ the length of the head. Origin of the dorsal midway betweeen the tip of the snout and the base of the caudal. Upper half of the first five developed rays of the dorsal black.

Brazil, 6 specimens, 14–17 mm. long.

7. *Mylesinus macropterus.* Body deep, 1⅘ in the length. Head 3⅓. Abdominal serrations 11 behind the ventrals, the posterior four in pairs, 22 to 25 smaller ones before the ventrals.

D. I, 16; A. 36; V. 7. Scales small, about 83 in the lateral line which is deeply curved below the origin of the dorsal. Height of dorsal fin 2⅔ times its length, the second and third rays greatly elongate, the fourth ray about half as long. Anal without lobes.

Snout little more than half as long as the diameter of the eye, the inter-orbital space a little more than the diameter of the eye. Lower jaw greatly projecting. Teeth in the mandibles in one series, notched and wide apart.

Brazil, 1 specimen 9 cm. long.

ALBERT B. ULREY, Bloomington, Ind.

On the Species of Himantodes D. & B.—This genus of snakes is represented by numerous individuals in tropical America, and sufficient material is now at hand to render it possible to determine the number of species to which they belong. An examination shows that

the typical species *H. cenchoa* L., does not occur in Central America and Mexico, the individuals which have been hitherto referred to it, representing another species, which I call *H. semifasciatus.* Of the seven species, five belong to this region, and two to continental South America.

I. A small additional superior preocular plate.

Scales in 17 rows; superior labials 4 and 5 in orbit; one scale in first temporal row; vertebral row enlarged; dorsal spots extending to gastrosteges throughout; *H. cenchoa*[3] L.

II. One large preocular plate only.

α. Scales in 15 rows.

One scale in first temporal row; superior labials 4, 5, and 6 bounding orbit; vertebral row enlarged; dorsal spots terminating in an angle near gastrosteges; no lateral spots; *H. lentiferus* Cope.

αα. Scales in 17 rows.

β. One scale in first temporal row.

[Two labials in orbit; vertebral scales enlarged; on posterior two-thirds the length the dorsal spots are small and lateral spots are present; exceptionally, *H. semifasciatus* Cope.]

Two labials in orbit; vertebral scales similar to the others, spots as in *H. semifasciatus;* *H. gemmistratus* Cope.

ββ. Two scales in first temporal row.

υ. Dorsal spots continued to gastrosteges throughout.

Vertebral row enlarged; superior labials 4 and 5 in orbit; *H. leucomelas* Cope.

Vertebral row like other scales; superior labials 4, 5, and 6 in orbit; *H. tenuissimus* Cope.

υυ. Dorsal spots reduced posteriorly; lateral spots.

Vertebral row enlarged; *H. semifasciatus* Cope.

[Vertebral row like others; exceptionally, *H. gemmistratus* Cope.]

III. A small inferior preocular plate.

β. Two scales in first temporal row.

Scales in 17 rows; vertebrals large, wider than long; labials 4 and 5 in orbit; dorsal spots continued to gastrosteges throughout; *H. anisolepis* Cope.

Himantodes lentiferus sp. nov. Besides the characters already mentioned, this species exhibits the following: Labials eight above, ten below. Seventh superior labial as high as long; temporals 1–2–3. Postgenials in contact anteriorly, separated by two scales posteriorly.

---

[3] Specimens from Brazil and E. Ecuador from Prof. Orton.

Superior postocular three times as large as inferior. Vertebral scuta wider than long. While the dorsal spots are acute angled below generally, they are not so on the tail and anterior region; on the latter many of them are separated by a much smaller vertebral spot. Top of head brown, brown spotted; lips and throat unspotted; other inferior regions black speckled. Total length 622 mm.; tail 189 mm. Pebas, Ecuador, J. Hauxwell; E. Equador, J. Orton.

The characters of this species are well marked, as compared with those of the *H. cenchoa*. Of the latter I have four from Peru (Orton) and one from Ecuador (Hauxwell.)

Himantodes semifasciatus sp. nov. The width of the vertebral series of scales varies in the numerous specimens I have assigned to the *H. semifasciatus*; in some the width is nearly equal to the length, while in others it is considerably less. The apices of the vertebral scales are, however, always truncate, and never acuminate like the other scales, as is seen in the *H. gemmistratus*. There are usually two scales in the first temporal row in this species, while there is invariably only one in the *H. gemmistratus*, but in three of the nine Costa Rican specimens there is but one scale. The largest specimens belong to the *H. semifasciatus*. One of these (No. 101) measures; total length 1125 mm.; tail 380 mm.

Ten specimens from Costa Rica; Paso Azul, Santa Clara, Carrillo, Alajuela, Monte Aguacate, and San José; from the Museo Nacional, through Geo. K. Cherrie. Two specimens in Mus. Academy, Philada. from Nicaragua.

Himantodes anisolepis sp. nov. Besides the characters already mentioned, the following may be noted. The small inferior preocular is cut from the fourth superior labial; the labials number eight above and ten below. The lower post-ocular is one-third the size of the superior. Temporals 2–2–3. The postgenials are entirely separated by scales. Thirty-nine brown spots from the head to the vent, which extend nearly to the gastrosteges, with truncate or rounded inferior border, on a very pale ground. Belly unspotted. Total length 420 mm. of tail, 127 mm. Monte Aguacate, Costa Rica, G. Witting.

This slender species resembles in coloration the *H. tenuissimus* and *H. leucomelas*. It differs sufficiently in scale characters from both.—E. D. Cope.

Zoological News.—M. de Guerne recently reported to the *Société Acclimatation de France* the capture in the open sea of a female eel bearing mature eggs. (Rev. Sci. March, 1894.)

Prof. Carl Eigenmann is in receipt of a Ling (*Lota lota maculosa*) from the Columbia River which does not show any specific differences from those of Lake Michigan. This fish is found in all three of the large water basins of the Atlantic slope—the Saskatchewan, St. Lawrence and Mississippi, and its distribution is now extended to the Pacific Slope. (Science Vol. XXIII, 1894.)

Distomum leptodon, a new Trematode from the intestine of *Aplodinotus grunniens* (River Drum) has lately been described by W. G. MacCallum in a paper before the Natural Science Association of Toronto University.

ENTOMOLOGY.[1]

The Pear Leaf Blister.—Mr. M. V. Slingerland has recently rendered an important service to economic entomology by showing that the injuries of *Phytoptus pyri*, the mite which causes the pear leaf blister can be controlled by spraying the trees in winter with kerosene emulsion. In a recent bulletin[2] he presents the most satisfactory account of this pest that has yet been published, recording the experiments which have led to the discovery of the remedy. The disease is said to appear on the leaves early in spring "in the form of red blister-like spots an eigth of an inch or more in diameter. During this red stage of the disease, the spots are more conspicuous on the upper surface of the leaves. About June 1, the spots gradually change to a green color hardly distinguishable from the unaffected portions of the leaf; this change takes place on the lower side of the leaf first, and the spots may thus be red above and green below. In this green stage, which seems to have been overlooked, the badly diseased leaves present a slightly thicker corky appearance; otherwise the disease is not readily apparent especially where not severe. This green stage lasts about a week or ten days; and about June 15, the spots may be found changing to a dark brown color beginning on the lower side of the leaf. The tissue of the diseased parts or spots then presents a dead, dry, brown or black, corky appearance. The spots are also more conspicuous on the lower side and remain unchanged until the leaves fall in the autumn. They occur either singly scattered over the surface of the leaves or often coalesce forming large blotches which sometimes involve a large portion of the leaf."

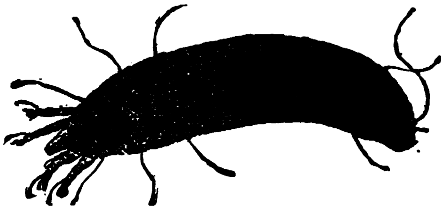


Fig. 1.—*Phytoptus pyri*. Magnified.

In describing the life history of the Phytoptus mite Mr. Slingerland says: "The exceedingly minute oval grayish eggs are laid by the females in the spring within the galls that they have formed, and here

---

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Cornell University Agr. Exp. Station Bull. 61, pp. 317–328

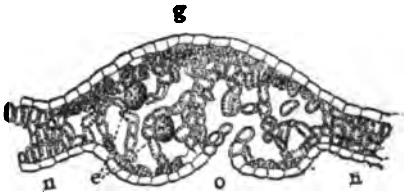


Fig. 2.—Section of leaf showing gall in red stage, *n*, *n*, normal leaf; *o*, opening of gall; *e*, eggs. (After Sorauer).

the young are hatched. How long they remain within the gall of their parent has not been ascertained. But sooner or later they escape through the opening in it, and seeking a healthy part of a leaf or more often crawling to the tenderer leaves of the new growth, they work their way into the tissue and new galls are thus started. In this manner the galls on a tree are often rapidly multiplied during the summer. The mites live within the galls, feeding upon the plant cells, until the drying of the leaves in the autumn. They then leave the galls through the openings and migrate to the winter buds at or near the ends of the twigs. Here they work their way beneath the two or three outer scales of the buds where they remain during the winter. Fifteen or twenty may often be found under a single bud scale. In this position they are ready for business in the spring as soon as growth begins; and they doubtless do get to work early for their red galls are already conspicuous before the leaves get unrolled.

"The mites instinctively migrate from the leaves as soon as the latter become dry. Whenever branches were brought into the insectary, as soon as the leaves began to dry, the mites left them and gathered in great numbers in the buds. It is impossible to accurately estimate the number of mites that may live in the galls on a single leaf. Sections of galls made while in their red stage would seldom cut through more than two or three mites; but sections of the brown galls often showed four or five times as many. Thus on a badly infested leaf there is without doubt at least a thousand of the mites."

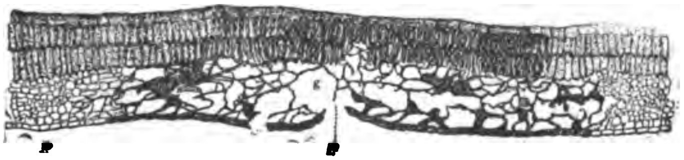


Fig. 3.—Section of the leaf showing structure of gall in autumn; *g*, gall; *n*, normal leaf; *o*, opening of gall.

The upper figure on the accompanying plate shows a cluster of infected leaves representing the brown stage of the disease as seen from below on three leaves and from above on one leaf; and the lower one shows part of an infested leaf, seen from below, with several of the galls considerably enlarged.

Termite Societies.—Professor B. Grassi and Dr. A. Sandias have investigated the nature and origin of the Termite society in *Calotermes flavicollis* and *Termes lucifugus*. A Calotermes colony may include (*a*) indifferent larvæ, capable of becoming soldiers or sexual members; (*b*) larvæ and pupæ of sexual members with rudiments of wings; (*c*) soldier larvæ and soldiers which may arise from *a* and *b*; (*d*) winged sexual insects: (*e*) a true royal pair with vestiges of wings; (*f*) larvæ of 'reserve' sexual members and the reserve kings and queens which arise from these. These last larvæ may be developed from *a* or from various stages of *b*.

In the Termes nest there is a special caste of workers and no distinctive royal pair. The society includes (*a*) very young indifferent larvæ; (*b*) larger larvæ and the workers and soldiers to which they give rise; (*c*) winged sexual animals; (*d*) various stages of reserve and complementary sexual animals.

The one type, that illustrated by Calotermes, is founded by a king and queen, who may be replaced by a pair of reserve royal individuals, *i. e.* by a 'neotænic' couple. The second less primitive type, illustrated by Termes, contains several 'neotænic' couples, while kings are only temporary; in this case the nest arises in a secession from an older colony.

One of the most interestsng results concerns the influence of nutrition in producing polymorphism. Thus the reserve sexual members are fed not only in the larval state but afterwards from salivary secretion only, a nutritive diet which probably hastens the rapid development of the reproductive system.—*Journal Royal Microscopical Society.*

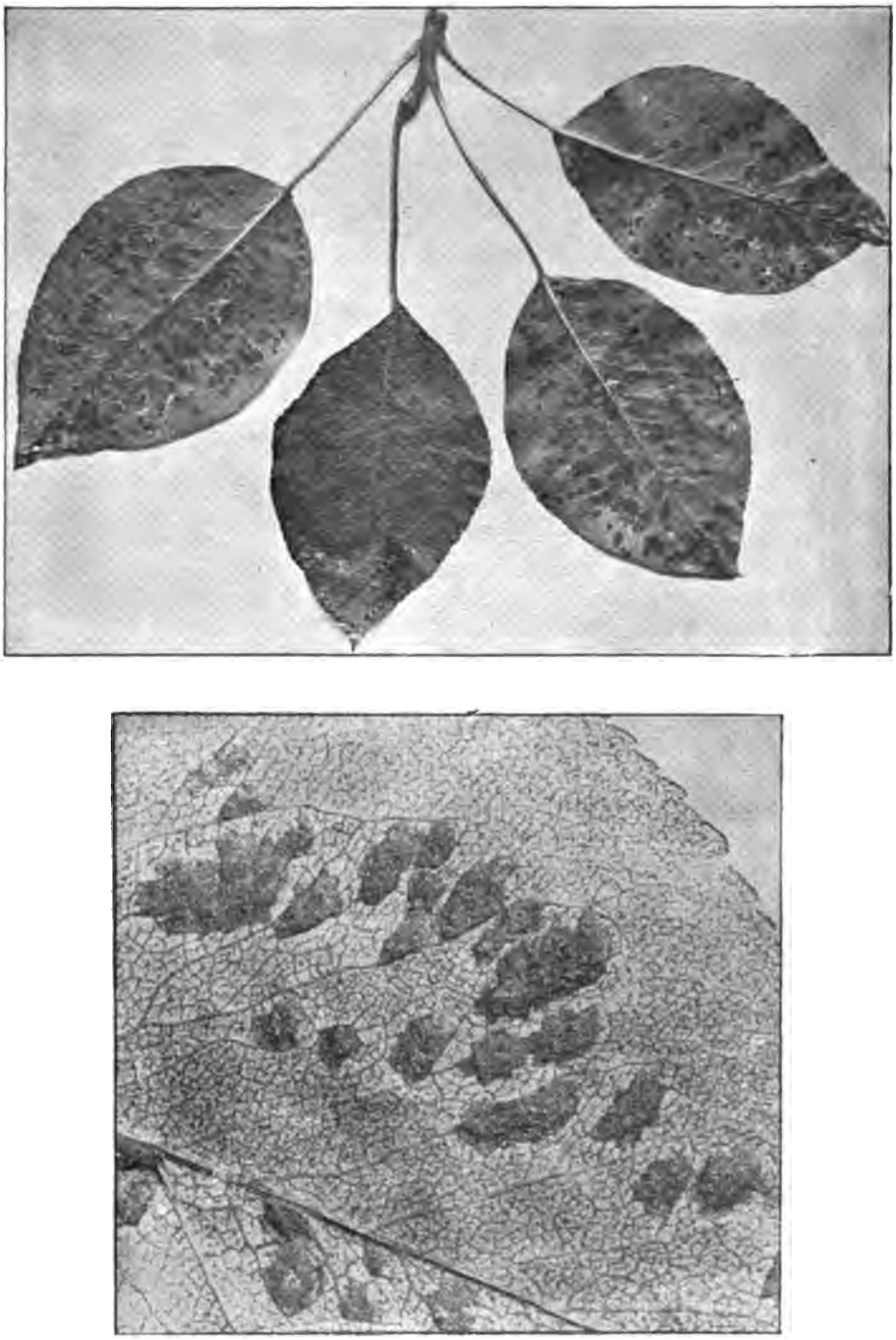
Habits of the Leaping-Ant of Southern Georgia.—In the pine forests upon the sandy loam of Thomas County, near Thomasville, Georgia, I discovered a nest of *Atta brunnea* (*Odontomachus brunneus* Roger.) No hillocks were formed, the openings to the galleries in the earth being at the surface level. The aperture was large enough to have allowed queens as large as those of *Oecodoma* to have passed, the workers (the only sex observed) of *brunnea* being much smaller. The workers jump several inches when disturbed, the leap being backwards and being caused by snapping the mandibles together.

The cocoon contains the pupa of the worker in September.

ATTA BRUNNEA (Roger). Georgia.

A. (*O.*) *hæmatodes* (L.) of the West Indies may prove to be a variety of this.

PLATE XVI.



Work of the Pear Leaf Blister Mite.

☿. Length 9 mm. Of a uniform brown color. Legs and sometimes the tip of the abdomen and the head and thorax, especially beneath, are paler. Mandibles finely serrate within; the tip tridentate, middle tooth smallest. Palpi invisible, obsolete.

Tibæ all one-spurred. Scale of the petiole produced into a spine. The thorax above is densely striate, the head above with finer striations.

ATTA CLARA Texas.

☿. Uniformly honey-yellow. Scale smaller than in *brunnea*, not forming a spine.

♂. Length. 6 mm. Head ordinary, as wide as long. Eyes oval, slightly sinuate both before and behind, black. Ocelli large, white. Antennæ long as body, not elbowed; brown, except first joint. Mandibles distant, minute, their tips touching. Palpi minute. Wings clear, veins yellow, recurrent vein received in base of second submarginal cell. Entire body and legs yellow. Abdomen hairy, second constriction deep, claspers large, scale rounded.

WM. HAMPTON PATTON, Hartford, Conn.

Note on the Winter-Ant.—Since writing the article upon this ant (AMER. NAT., Oct., '92) I have found the sexes paired in flight, at Hartford, Conn., on the third of August. This indicates the existence of a second or summer brood of the species. The male of *Prenolepis imparis* (Say) Patton, measures only about one-eigth of an inch, the female is twice as long and much more bulky. The sexes also differ in color, the males being black, the workers dark brown, and the females dark honey-yellow.

WM. HAMPTON PATTON.

PHYSIOLOGY.

Attenuation of Viper Poison.—In a commnnication published in Revue Scientifique Feb., 1894, M. M. C. Phisalix and C. Bertrand published the results of experiments made with the venom of vipers. Fresh venom from *Vipera aspis* extracted from the glands rapidly loses its virulence when subjected to a temperature of 75°–80°, and an aqueous solution so treated exhibits energetic innoculating properties against the venom itself.

They have also demonstrated that the blood of animals innoculated with this *echidno-venin* becomes antitoxic, the injection of this defibrinated blood or of the serum into the peritoneal cavity of healthy guinea-pigs, neutralized the effects of the venom.

They add that the blood of guinea-pigs protected by a poison habit, that is, by injections of pure venom in increasing quantities, administered at gradually decreasing intervals, is also antitoxic, but to a less degree than that of animals protected by vaccination. Animals protected by innoculation with antitoxic serum preserve their immunity quite a long time.

Their observations are such as lead them to believe that this antitoxic serum will prove to be a therapeutic agent. •

Since then, M. Calmette, who had questioned the correctness of the results of their experiments, but who later retracted his assertions, has presented a note in which he annnounces " that one can protect animals against the venom of serpents by means of repeated doses of poison, at first weak, but gradually increasing in strength . . . . . and that the serum of the animals thus treated is at once protective, antitoxic and therapeutic." This is precisely what M. M. Phisalix and Bertrand demonstrated; but M. Calmette, not having cited their researches, they think they should lay claim to priority in publishing the important theoretical and practical consequences of this discovery, having been able to give in logical sequence the facts upon which the results are scientifically established. (Revue Sci., May, 1894).

The Secretion of Urea.—It is well known that urea exists already formed in the blood when it reaches the kidneys, and that so far as this substance is concerned, the kidneys function as eliminating organs. But in what part of the organism then is the blood charged with the urea? The researches of M. Kaufman, who has been at work

at this problem for several years, have furnished results from which he draws the following conclusions:

1. The formation of urea does not take place in the liver alone; all the tissues produce a certain quantity.
2. The liver, however, is the most active secreter of urea in the young animal.
3. The production of urea seems to accompany the phenomena of nutrition which occur in the different tissues, and the phenomena of elaboration and of preparation of nutritive materials constantly poured into the blood by the liver. (Revue Sci., Mai, 1894).

ARCHEOLOGY AND ETHNOLOGY.[1]

Tobacco pipes in Shell-heaps of the St. John's.—By those familiar with the archeology of Florida, it will be remembered that the extended and careful researches of Professor Wyman among many of the shell-heaps of the St. John's river yielded no pipes, fragmentary or otherwise, intended for the smoking of tobacco, and that naturally the conclusion was arrived at by him that in all probability the makers of the shell-heaps were ignorant of its use.[2]

During the first two years of our investigations on the St. John's the negative results obtained by Professor Wyman awaited us also, though at the conclusion of our third season, in the island shell-heap constituting Mulberry Mound,[3] on the southern border of Orange County, near Lake Poinsett, we discovered at considerable depth from the surface a fragment of a tube of earthenware, which we believed, and which was pronounced by competent authority, in all probability to be a portion of a pipe used for the smoking of tobacco.

In the small burial mound situate on the northern extremity of the shell-heap we found two other fragments still more markedly indicating a similar use when entire. Nevertheless, the shell-heap fragment and those from the burial mound, assuming the contemporaneity of the two, while strong evidence as to the presence of tobacco pipes in the shell-heaps, were not final.

At the close of our fourth and last season of investigation of the river mounds (April, 1894) we again visited Mulberry Mound, making an excavation about 16 by 24 feet and 16.5 feet in depth to the water level.

At a depth of 6 feet from the surface was discovered a tobacco pipe of earthenware, complete in every part, of which we give a representation. (Plate XVII.)

Thus we have positive evidence that the men under whose feet slowly grew the great mass of powdered shell and other kitchen refuse now known as Mulberry Mound were familiar with the use of tobacco.

It is fair to explain, however, as we have previously stated in the NATURALIST, that Mulberry Mound is by no means a type of the shell-heaps of the river, since the debris of which it is composed is compara-

---

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

[2] "Fresh Water Shell Mounds of the St. John's River, Florida," page 59.

[3] Naturalist, Aug. 1, 1893.

tively rich in relics connecting it with a period presumably much later than most of the shell-heaps which yield little or nothing to the investigator, some even giving no evidence of the presence of sherds to the most careful and prolonged search.

The failure to find tobacco pipes in the other shell-heaps after years of investigation may at least suggest the question whether the smoking of tobacco was practiced when the older shell-heaps were made. It might be suggested, however, that, as in upwards of eighty sand mounds of the river, the majority of which were leveled to the base by us, but five tobacco pipes were met with, a proportionate infrequency of occurrence might be expected in the shell-heaps. To this we would reply that we by no means concede the contemporaneity of the sand mounds with the earlier shell-heaps; and even were a contemporary existence shown one might expect pipes, or fragments of pipes, in greater numbers in shell-heaps which represent longer periods of occupancy than in the sand mounds. The deposit of articles and certain classes of articles in the sand mounds was voluntary and dictated by custom; while into the debris of shell-heaps objects found their way through loss, if unbroken, and through rejection, if fragmentary or imperfect. Articles discovered in the shell-heaps afford a fair idea of the possessions of the men who made them. Most of us know to our cost the fragile character of a tobacco pipe of earthenware, and it is quite evident that portions of pipes accidentally broken, not to be expected in the sand mounds, since these "high places" were not used for domicile during construction, must be looked for in the shell-heaps whose makers lived upon them.

We are, therefore, of the opinion that the finding of a tobacco pipe in so exceptional and in such a presumably late shell-heap comparatively as Mulberry Mound, does not establish the use of tobacco as existing among the makers of the earlier shell heaps of Florida.

CLARENCE B. MOORE.

Norse Remains in the Neighborhood of Boston Bay.[4]— The late Professor E. N. Horsford was the first to call attention to the evidences of the truth of ancient Sagas which claim for the old Sea

---

[4] I received the following paper from Mr. Gerard Fowke, late of the Bureau of Ethnology, Washington, last night (June 27, 1894).

Archeology must watch with keen interest and sympathy the work undertaken by him for Miss Cornelia Horsford of excavation at the alleged sites of Norse occupation in the Charles River Valley, Massachusetts. Much discussion and prejudice has beclouded the important problem which he and Miss Horsford have

Rovers of Norway the honor of discovering America nearly five centuries before Columbus. He spent many years in this study and found dams, docks, wharves, artificial islands, ditches and canals, that could not be accounted for by any known works of either English or Indians —though this conclusion was not forced upon him until long after he had begun his investigations. With untiring industry he collected and pored over scores of ancient and almost inaccessible maps and manuscripts, and went afoot over nearly every acre for miles in the Valley of the Charles. Despite all this, his work is not known to the world at large as it should be, nor appreciated at its value outside of a very small circle of those who are ready to listen to proofs instead of dismissing as groundless statements they will not be at the trouble to verify by a slight outlay of time and labor.

Professor Horsford preferred not to make any excavations until every other source of knowledge had been exhausted; and it was not until May of this year that careful examination was made of certain places that seemed to promise good results.

Most important among these was the site of the house built by Thorfinn, who planted the first colony in A. D. 1007, within a few rods of the present site of the Cambridge Hospital. It was discovered that the foundation wall had been made by digging a trench around a rectangular space measuring about sixteen by sixty-four feet. In this trench, which was about two feet in width, were placed stones varying in size from small pebbles to boulders as large as man could readily lift, and in sufficient numbers to prevent the logs or timber resting on them from coming in contact with the earth below or at the sides; but they did not extend above the surface.

Within this foundation, at nearly equal distances from the ends and from each other, were two circular pavements some four feet in diameter, of small stones carefully laid in by hand. They were in the proper position for hearths or fire-places, but although the earth under and about them contained charcoal and ashes, the stones themselves showed no marks of heat.

The building was very similar to the long houses of the Iroquois; the same type may also be found among the timber cutters in our pine forests.

before them, but the truth will now lie with him who digs without fear or favor. If the Sea Rovers lived long there, and built many houses, if they buried many dead there, then the sure evidence of arts known and practiced by Norsemen will see the light, and Mr. Fowke will not ask his friends to agree with him till he holds such proof in his hands.

H. C. Mercer.

Another type of houses, of which there are numerous examples, consists of a cellar-like excavation in a hill side, the floor being level and the height of the back wall varying according to the slope of the hill and the size of the house.

The first of these opened is near Stony Brook Station on the Fitchburg Railway. It is just at the foot of a kame, and at a point where an ancient dam extends across a little brook a few yards away. At the front was a wall about sixteen feet long of small boulders; another wall of similar stones was a foot within this, somewhat shorter than the first and slightly curved. From the ends of these walls the ends of the hut were marked by two rows of stones at irregular intervals, four or five boulders similarly placed marking the line of the back wall. At the middle of the excavated area was a carefully placed layer of pebbles, covering a space seven feet long and three feet across. This was very probably a hearth, though as in the case of Thorfinn's house there were no marks of heat. At the left front corner of the house was a pavement four by five feet of cobblestones, extending toward the end of the dam, but not reaching to it.

A short distance from this hut site was another not more than ten feet square within the foundation walls. There was no continuous wall in this; but at each front corner three or four stones had been piled to make a support for the timbers, and a row of stones extended for five feet back from one corner. One stone at the opposite side, and two or three at the back formed the remainder of the foundation. There was a small pavement of pebbles at the center but they were not arranged in any order.

A third hut, not far from East Watertown, differed from all others opened in being narrower at the back than at the front. Boulders were at each front corner, one on each side, and two at the rear. The evidence was more distinct in this than in the others, that the roof had been of sod or turf with a covering of small stones, as the interior space was filled for more than a foot in depth with a mingled mass of black earth and pebbles that could have come only from the caving in of the top.

At several places, in the neighborhood of these houses are ancient cemeteries, most of them on sloping ground, some of them on hill sides so steep as to be difficult of ascent. The grave sites are indicated by cairns, generally about six feet in diameter, few of them varying a foot from this size. It has been generally supposed that these stone piles are due to the clearing up of the ground at some former time: but many of them are on slopes so steep that no effort at cultivation

would ever be made; some are composed entirely of pebbles few of which exceed a goose egg in size while all about them are large boulders that would materially interfere with any farming operations that might be attempted. In only one of the graves opened was there any evidence of an excavation more than a few inches in the soil. It appears that the body was laid on the surface with a covering of brush or timber over which the stones were piled. It would seem scarcely reasonable that a people as far along toward civilization as the Norse were at that time would adopt such a mode of burial; but these cairns were beyond doubt intended for this purpose, and it must be remembered that in their native home the scarcity of soil made it necessary that corpses be thus disposed of instead of being interred. People tenaciously adhere to what is customary in such matters—as witness the wide-spread opposition to cremation.

What has been so far done in the field is only a beginning; while Professor Horsford has seemingly left little for any one else to do in collecting maps and collating the evidence of history as embodied in the Sagas, it is possible there may yet be among the old Scandinavian and Icelandic records something that will throw unexpected light on the subject. But there remains a great deal to do in the strictly archeologic line. More of the hut sites are to be excavated, and the soil immediately around them and the long houses is to be carefully examined, as there is always a possibility of the preservation of some object that will furnish indubitable proof of what is sought. This is necessary not alone in the vicinity of Cambridge, but all along the coast from Long Island Sound to the Saint Lawrence, as this whole region is said to contain to some extent remains similar to those above mentioned. A careful study is desirable also, of the sites of settlements in other countries where these people have lived; especially in Greenland whence many if not a majority of the earliest settlers of the Charles River Valley were derived.

GERARD FOWKE.

Progress of field work in the Department of American and Prehistoric Archæology of the University of Pennsylvania.—The believer in Man's great antiquity in Eastern North America is again called upon to explain a serious doubt. The easily accessible broad and well lit shelter of the Forge Cave (1 mile below Barren Springs, left bank of the New River, Pulaski County, Virginia), as explored by us in February, 1894, has astonished us again with the modern look of the evidence furnished.

Instead of several ancient midden beds interlaid with stalagmite breccia or cave earth indicating the lapse of successive epochs and the comings and goings of pre-Columbian peoples, our six-sectioned trench, 36x24x10 feet (Section 3 to rock bottom) at deepest, showed:

(1) Red earth left by nitre leachers in 1863–64, with bottle glass, nails, domestic fowl bones, etc., 15–17 inches. (White Man).

(2) Charcoal and ashes in hearth layers, sometimes invaded by diggings from above, sometimes undisturbed, with arrowheads, chips, unglazed pottery, and bone awls, 7 to 9 inches. (Predecessor of White Man).

(3) Rough, unworn blocks of limestone, larger towards the bottom, containing, for some distance down, infiltrations from layer No. 2, resting on the rock floor, 8 feet. (No trace of human or animal occupancy).

Here then, as at the Nickajack and Lookout Caves in Tennessee (explored in December, 1893), we had found but a single stratum of human occupancy (no. 2) below the superficial glass, nails and domestic animal bones of the White Man.

While in it (stratum 2), instead of a predominance of the relics of extinct or probably ancient animals bedded in the fossil preserving charcoal, we discovered the presumably modern remains (kindly identified by Professor Cope) of the Unio, Paludina, Catfish, Tortoise, Frog, Domestic Fowl, Bird (undetermined), Turkey, Marmot, Ungulate (undetermined), Beaver, Lynx, Domestic Sheep, Elk and Deer.

Only in one instance gnawed by rodents and often interlaid between undisturbed hearths, the presence and position of the bones and shells demonstrated them to be the remains of a fauna preyed upon by Man, while the 5 potsherds (3 showing decorative incisions), the 12 bone awls, the triangular chert arrowhead and infrequent hornstone chips, found in the midden layer, proved it the work of the same Indian, who, 8 miles above had scattered his riverside camp site with bones of the Deer, and had dropped pottery, earthen pipes, a polished celt, hornstone chips, and hammer stones. At a surface feasting place twenty miles below, I found the remains determined by Professor Cope to belong to the Unio, Paludina, Trypanastoma, Catfish, Turtle, Soft Shelled Turtle, Raccoon, Bear, and Deer.

This proof that no earlier people than the Indian resorted to the Forge Cave (and the Lookout and Nickajack Caverns), may indicate that no earlier people than the Indian ever inhabited the upper valleys of the New River and the Tennessee. But further search is needed to

establish the conclusion, while objections to the final value of all such cave layer tests for Man's antiquity must be thoughtfully weighed.

The first is suggested by Professor Cope, that as the caves explored by me lack fossil remains, the old (Plistocene) ends of caves with their animal and, if we can believe it, human remains, have probably been worn away. Caves, therefore, would not tell the whole human, as they do not tell the whole animal story, since Man may have inhabited parts of caves which have disappeared.

This, if true, would exclude the alleged Tertiary Man of Thenay or Otta from caves, but would leave us our witnesses for any possible Plistocene blade chipper of Trenton and Madisonville.

Another objection to cave evidence is advanced by Dr. Brinton. Like the Veddas of Ceylon (who are supposed, on the authority of the brothers Sarasin, to have avoided rock shelters), early Man, he suggests, was probably *arboreal* and did not inhabit caves. But continual avoidance of available and conspicuous natural shelters by primitive peoples anywhere is hard to imagine. We have the trace of all kinds of Paleolithic, Neolithic and post-Neolithic peoples in caves in Europe and the evidence of explorers as to still existent savages visiting caves is scanty and insufficient.

If we are not hunting "Cave Dwellers," and if proof of Man's presence is all we want, then a few surface gathered trouser buttons and bottle chips will do for the White Man, arrowheads and bone needles for the Indian, and a breccia—let us suppose with Mylodon teeth and "Turtlebacks"—for some one else. Nothing short of cave avoidance by the savage will rob us of the evidence which a fire kindler or two in a century would suffice to furnish.

H. C. MERCER. March, 1894.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Entomological Society of Washington.—June 7, 1894.—The 100th regular meeting. Twenty-two members present. Mr. Charles Palm, of New York City, elected a corresponding member. President Ashmead made some brief remarks congratulating the Society upon attaining its 100th meeting and upon its prosperous career and prospects. The Recording Secretary, Mr. Howard, read a review of the work of the Society during the past ten years. Mr. Pergande presented certain additional observations upon the habits of *Ammophila gryphus* for publication. Mr. Benton read a paper entitled "Observations on the Mating of Queens of *Apis mellifica*," showing that the queens mate twice. Discussed by Messrs Riley, Gill, Schwarz and Pergande. Mr. Chittenden presented for publication some biological notes on certain Coleoptera. Mr. Schwarz presented a paper on the composition and extent of the Coleopterous fauna of Alaska, giving a lengthy outline of the history of the entomological exploration of that country, commenting upon the results of a trip taken by himself and Mr. H. G. Hubbard in 1892 through parts of Oregon, Washington and British Columbia, and showing that the Alaskan fauna predominates along the coast range of Oregon and Washington. Discussed by Dr. Gill. Mr. Schwarz also read some notes on the West Indian Sugarcane Borer (*Xyleborus perforans*) and showed the difficulty of determining whether this insect really occurs in the United States. Discussed by Messrs Riley and Howard. Under the head of short notes and exhibition of specimens, Mr. Heidemann exhibited certain rare Pentatomids and Professor Riley announced the rearing of perfect females of Margarodes. He showed that Margarodes and Porphyrophora are synonyms.

L. O. HOWARD,
Recording Secretary.

N. Y. Academy of Sciences, Biological Section, May 14.—The following papers were read:—

Professor E. B. Wilson, "Experiments on the Horizontal Isotropy of the Egg;" Dr. Arnold Graf, "On the funnels and vesiculae terminales of *Nephelis*, Clepsine and Autostoma;" O. S. Strong, "On Lithium bichromate as a hardening reagent for the Golgi method."

BASHFORD DEAN,
Rec. Sec. of Section.

Boston Society of Natural History, May 16.—The following paper was read:

Mr. A. W. Grabau: Ancient and modern channels of the Genesee River. Stereopticon views were shown.

SAMUEL HENSHAW,
Secretary.

SCIENTIFIC NEWS.

Professor G. J. Romanes.—We have to announce the recent sudden death of Professor Romanes. He was born in Kingston, Canada, in 1848, and graduated at Cambridge, England, in 1870. In 1873 he was Burney prize essayist, and Croonian lecturer in 1875. His first important investigation was on the anatomy and physiology of the nervous system of the Medusae, and he first placed our knowledge of this subject on a definite basis. His works on the evolution of mind in the lower animals and man are the best we have on the subject. He was a prolific writer on evolution, and leaned sometimes to the Neolamarkian, sometimes to the Neodarwinian opinions. In his latest work he revised the opinions of Weismann, and showed the important modifications which they have undergone. The death of Professor Romanes is a serious loss to science.

The Peary Auxiliary Expedition.—The members of this expedition dined together at St. Georges Hotel, Brooklyn, June 17th, preparatory to taking passage on the steamer Portia for St. Johns, N. B. A farewell dinner was given to Henry G. Bryant, the leader of the expedition and his colleagues at the Art Club, Philadelphia, on June 18th by the members of the advisory committee of the Geographical Club. At St. Johns they expect to be joined by the steam whaler Falcon, on which they will sail for North Greenland to look for Lieut. Peary and his party.

The members of the expedition are Professor Wm. Libbey, Jr., of Princeton University, geographer; Professor T. C. Chamberlin, of the University of Chicago, geologist; Dr. Axel Ohlin, of Sweden, zoologist; Dr. H. E. Wetherill, of Philadelphia, surgeon; H. L. Bridgman, of the Brooklyn Standard-Union; Emil Diebtsch, of Port Royal, S. C., civil engineer.

When the Portia sails to-morrow she will have on board the usual Arctic outfit of snow shoes, sledges, ice axes, tents, etc. The vessel

will probably reach St. Johns about the 26th of this month, and by the 4th of July, it is thought, the Falcon will sail for the far North.

It is hoped that Peary's headquarters in Bowdoin Bay will be reached by July 25. If assured of the safety of Peary's party, some of the members of the expedition will then pay a brief visit to Ellesmere Land in their search for the missing naturalists, Bjorling and Kallstenius, who were ship-wrecked on the Carey Island two years ago.

The auxiliary expedition and the Peary party, it is expected, will leave Bowdoin Bay, September 1, and sail on the Falcon for this city, arriving here probably by the 15th of that month.

The Retirement of Professor Dana.—The resignation of Professor Dana from the position he has long held in Yale University is announced.

Professor Dana is eighty-one years of age, and is compelled to abandon further active work by feeble health. His resignation has just been accepted. He graduated from Yale in the class of 1833, returned to college as tutor and succeeded to a full professorship fifty years ago. Since then he has had charge of the department of natural science.

Born in Utica, N. Y., February 12, 1823, Dr. Dana early became interested in the researches of Professor Benjamin Silliman, and through them was attracted to New Haven. Under his guidance he was graduated from Yale in 1833 and immediately appointed instructor of mathematics to midshipmen in the United States Navy, and in this capacity visited the seaports of France, Italy, Greece and Turkey while on board the warships Delaware and United States. In 1836–38 he was assistant to Professor Silliman in the department of chemistry at Yale, and while thus engaged was appointed mineralogist and geolgist to the exploring expedition to the Southern and Pacific Oceans under Captain Charles Wilkes. He was on the corvette Peacock, wrecked at the mouth of the Columbia River. He returned in 1842 and spent some years on his portion of the report, which was partly prepared in Washington. In 1844 Dr. Dana married Professor Silliman's daughter, Henrietta Frances, and he has since continued to reside at New Haven. In 1850 Dr. Dana was appointed Silliman Professor of natural history and geology at Yale, and the same year became associate editor of the *American Journal Science and Arts*, founded by the elder Silliman in 1819. Later he became editor-in-chief, with his son, Edward S. Dana, as assistant. In 1872 the Geological Society of London conferred on Dr. Dana its Wollaston med-

al, and in 1877 he received the Copley gold medal from the Royal Society of London. He is a member of many of the leading scientific societies of the world, and was President of the American Association for the Advancement of Science in 1854. In 1872 the University of Munich gave him the degree of Ph. D., and in 1886 at the Harvard celebration he was awarded the degree of LL. D.

Professor Dana's principal works have been on Corals and Crustacea, and in Geology and Mineralogy. His text-books of the latter subjects are so well known as to require only mention here.

The Wistar Institute of the University of Pennsylvania.—This important addition to the many courses of the University is the gift of General Isaac J. Wistar, a son of Dr. Caspar Wistar, one of the earliest professors of anatomy at this institution. The preservation and exhibition of the Wistar Anatomical Museum is the principal object of the institute. There will also be added to it a complete collection of all objects necessary for the successful study of biology, anatomy and the historical development of the organs in man. The department will be so thoroughly equipped from a scientific standpoint that it will be used not only for purposes of exhibition but also for practical teaching. Advanced research will be the most striking feature of the work.

In connection with the institute there will be established a course of lectures which will give graduates of the medical department opportunities for post-graduate courses and deeper research in the advanced stages of anatomy and biology.

A periodical will be published, in which these subjects will be treated by men who have become celebrated because of their knowledge of these important subjects. In this building will be placed the present museum of anatomy, known as the Wistar and Horner Museum, which was presented to the University by the widow of Dr. Caspar Wistar, which gift was afterward supplemented by those of Mr. Horner. In addition to this the museum now used in connection with the Biological School will be placed in the building as soon as it is completed.

It has been decided to place the management of this institute under the direction of a Board of Managers elected by the Trustees of the University. In order that the memory of the founder of this department may be perpetuated in fitting recognition of the appreciation felt at the benevolence of General Wistar, it has been settled that one of the managers shall be a descendant of the Wistar family. The other

two will be the President and Vice-President of the Academy of Natural Sciences.

The University will elect a dean of the department, who will devote his entire time and energies to the development of the manifold interests of the institute, which gives promise of being one of the greatest of its kind not only in this country, but also will rank high among similar departments in the European schools of anatomy. Fellowships will be established in order to afford deserving students ample opportunity for extended researches in this department.

Dr. Horace Jayne, the retiring dean of the college department of the University, has presented his famous anatomical collection, purchased some years ago from the renowned Collector Wade, to the Wistar Institute. The collection is composed principally of mammals, including a large number of alcoholic specimens and a complete set of rhinoceros skeletons.

Work on the building was begun less than two years ago. It is of buff brick, plainly but handsomely finished in buff terra cotta, and so constructed as to permit of additions being made with facility. The structure is thoroughly fire proof, and is provided with the most approved fire-escapes. It has a depth of sixty-six feet on Woodland Avenue, and a frontage of two hundred and thirty-seven feet on Thirty-sixth Street. On the latter thoroughfare is the broad entrance leading into a large vestibule eighteen by twenty feet. To the left of the entrance the curator's room is situated, and to the left is the lecture room connecting with the professor's room. The main entrance from the vestibule leads into the main hall, the dimensions of which are forty-four by thirty-six feet.

Passing through the hall to the left one will find the main museum a roomy apartment of fifty by one hundred and ten feet, furnished throughout with all the appliances necessary for an institution of the sort. Two smaller rooms toward the Spruce Street end are reserved for the reception of private collections.

The second floor will be devoted principally to work-rooms and professors' apartments. It will also contain a library and a museum corresponding in size to the one on the lower floor. Three more work-rooms are located on the third floor, with quarters for the janitor. There will also be another museum formed of galleries eighteen feet wide, overlooking the similar department on the floor below.

The basement will be devoted exclusively to work-rooms, all of which will be furnished with zincs, flues and other appliances necessary

for dissecting work. The height of the basement is twelve feet, and that of the other floors, fourteen, twelve and twelve respectfully.

At the opening exercises, there was a fair assemblage notwithstanding the very unfavorable weather. Addresses were made by Provost William Pepper, Director Harrison Allen, M. D., and Professor William Osler, M. D., of John Hopkins, formerly of the University of Pennsylvania.

Major J. W. Powell has resigned from the Directorship of the U. S. Geological Survey, and Mr. C. D. Walcott has been appointed by the President and Senate to take his place.

Professor H. S. Williams formerly of Cornell University, takes the place of Professor J. D. Dana in Yale University.

Among the books announced by MacMillan & Co. for early publication are:—"A three months course of practical instruction in Botany" by F. O. Bower; a "Course in Experimental Psychology" by J. McK. Cattell; "Physiology for Beginners" by Michael Foster; "Methods of Histological Research" by C. von Kahlden, translated by C. Morley Fletcher; "Text-book of Invertebrate Embryology" by Korscheldt and Heider, translated by E. L. Mark and W. M. Woodworth; "Lectures on Human and Animal Psychology" by Wilhelm Wundt, translated by J. E. Creighton and E. B. Tichener; and a series, the "Cambridge Natural Science Manuals" edited by A. E. Shipley and containing "Elementary Paleontology—Invertebrate" by Henry Woods; "Practical Physiology of Plants" by F. Darwin and E. H. Acton; "Text-book of Physical Anthropology" by Alex. Macallister; "The Vertebrate Skeleton" by S. H. Reynolds; "Fossil Plants" by A. C. Seward; and "Elements of Botany" by F. Darwin.

We regret to learn that our contemporary "Science" has suspended publication for want of sufficient financial support.

The Philadelphia Zoological Garden has received specimens of the Indian cats, *Felio bengalensis* and *F. viverrinus.*

Errata in June NATURALIST.—For Fig. 4, p. 530, read Fig. 2. For Fig. 2, p. 529, read Fig. 3. For Fig. 3, p. 530, read Fig. 4.

PLATE XVII.

Tobacco Pipe of Earthenware from Shell-Heap, Mulberry Mound, Florida, (full size.)

THE
AMERICAN NATURALIST

Vol. XXVIII. August, 1894. 332

THE ORIGIN OF THE VERTEBRATE SKELETON.

By J. S. Kingsley.

Until a very recent date, not a doubt existed that any part of the vertebrate skeleton was of other than mesodermal origin. The cartilages were mesoderm, and in their further development the cartilages were transformed into bone by means of the cells from the same parent layer. The membrane bones of the skull were also believed to mesodermal, since the researches of Oscar Hertwig ('74) had shown that in the Batrachia especially, as well as in other forms, they arose from the layer which formed the dentine of the teeth, and which was homologous with that which formed the dentine of the placoid scale. The details of this need not be given here, as they will will be found in every text-book; the point to be emphasized is that dentine and its homologue membrane bone were assumed to be, and even thought to be proved to be, of mesodermal origin.

One of the first papers to lay a foundation for a different view was one by Kastschenko ('88), which, while saying nothing of the origin of the skeleton, pointed out that certain parts of the mesenchyme were of ectodermal origin. Next, another Russian, Goronowitsch ('92), showed that in the formation of the "ganglionic folds" into the head, not all the tissues proliferated from the ectoderm into the "ganglienleisten" was used up in

the formation of nervous matter, but that some of it became mesenchymatous and was possibly utilized in the development of the skeleton. Other authors at about the same time confirmed more or less clearly this view that all mesenchyme was not of entodermal, but that at least some of it was ectodermal, in origin.

In 1893, Miss Julia B. Platt, in a preliminary paper, made the noteworthy statement that the embryology of Necturus showed that, at least in the head, the cartilages were derived from the ectoderm. Necturus was especially favorable in this respect, for its cells are larger and pigment is absent. At about the stage of the formation of the ganglienleisten, the differences between the entoderm and mesothelial tissues on the one hand, and the ectoderm on the other, were very great, the former being loaded with yolk granules, the latter containing comparatively few. Further, the layers readily differentiated by staining with the Erlich-Biondi mixture. With the formation of the ganglienleisten from the ectoderm, its cells could be distinguished in the same way, and it was found that only the dorsal portion of ridge becomes nervous, the lower contributing its cells to the mesenchyme, while between the two regions there was a portion which contributed to both tissues. These ectodermal mesenchymal parts (mesectoderm, as Miss Platt calls them) can readily be distinguished after their separation from the parent layer by the peculiarities already mentioned. From these proliferations tissue arises which later forms the gill cartilages, while further in front, near the eyes and the nose, similar ingrowths are seen, and especially in the region where the mouth is to break through. From these last arise at least the trabecular cartilages; the origin of the parachordals and otic capsule is not given.

In a second paper ('93^a), Miss Platt further elaborates some of her earlier statements, illustrating the parts with three figures, one of which shows the downward growth of the mesectoderm, to use her extremely convenient term, between the gill clefts and in the region of eye and nose.

Before the appearance of Miss Platt's second paper, Goronowitsch published his detailed account ('93), fully confirming

the statements of his preliminary, and showing that ectodermal ingrowths occur in the birds in just such positions as to justify the view that they gave rise to skeletal structures. Some of these, according to Goronowitsch, found their destiny in the cutis, a fact to be remembered while considering the work of Klaatsch, outlined below. A little later (93^a) Goronowitsch published a short note in which, among other points, he claimed that Miss Platt had not made good her thesis that these mesectoderm cells gave rise to the cartilage. Miss Platt's final paper will, we understand, soon appear.

The most important and most detailed paper of all is that of Klaatsch, which appeared in April of this year. Its title—" On the Origin of the Scleroblasts. A Contribution to the Knowledge of Osteogenesis "—shows its scope. We can give but the merest outline of the points detailed in the 90 pages of the paper.

The first point considered is the development of the placoid scale. This, as is well-known, consists of two portions, a harder outer portion, the enamel secreted by the basal ends of cells of undoubted ectodermal origin; and a deeper dentine which, up to now, has been universally regarded as of true mesodermal nature. Klaatch studied the development of the placoid organ in several species of Acanthias, Mustelus and Heptanchus. These presented various differences, but in general, they agreed in the following features. In the earlier stages the ectoderm is two cells in thickness, a flattened superficial layer and a deeper cubical or columnar layer. Between this last and the corium is a clear space, and there is no continuous basal membrane. A little later this deeper layer begins to undergo modifications, cells being budded from it into the clear space. These cells are readily seen to belong to the ectoderm, not only from the directions of the mitotic spindles, but from the fact that their nuclei are greatly larger than those of the corium, the only other layers from which they could arise. These cells are the scleroblasts. They are not scattered irregularly through the clear space, but are more abundant in some places than in others, thus early marking out the positions of the later placoid organs. With the modi-

fications of the ectoderm described by Klaatsch, we have nothing to do here further than is concerned in the scale development. It is to be noticed that along with the formation of the little patches of scleroblasts the overlying cells of the basal layer become elongated, the first step in the development of an enamel organ. The later stages in their general features are much as described by Oscar Hertwig in his classic paper of twenty years ago, and yet there are important differences to be noted. The heaping up of the scleroblasts continues, the result being the formation of the dentine organs, carrying with it the superposed enamel cells in the form of a pyramid. The enamel organ is terminated on all sides by a groove, and even at this stage the cells at the bottom of this groove are actively engaged in proliferating additional scleroblasts which are pushed into the still-growing dentine organ. The necessary conclusion is not only is the enamel of the placoid scale an ectodermal derivation, but such is the nature of the dentine as well.

Now placoid scales and teeth have long been regarded as homologous structures, and so Klaatsch studies the history of the latter. In the sharks he finds that the conditions of the development of the scales are paralleled in the ontogeny of the teeth. There is the same early proliferation of scleroblasts into the clear layer, and later, when the enamel cap is formed, its limiting groove is the seat of additional ingrowth of dentine-forming cells. In short, we must no longer regard the teeth as structures derived from two germ layers—ectoderm and mesoderm—but as purely ectodermal products.[1]

In the fin of the shark are numerous horny rays, and their history is followed. Earlier workers had universally regarded them as belonging to the connective-tissue series, although in 1885 Krukenberg had shown that their organic base was different from the chemical standpoint from the other connective tissues. Klaatsch finds that here there is a similar inwander-

---

[1] It is to be noted that in the recent meeting of the Anatomische Gesellschaft at Strassburg, May 13–16, Professor Rabl had a paper "Ueber die Herkunft des Dentinkeims in den Placoidschuppen und den Zähnen der Selachier (gegen Klaatsch)." The publication of this will be waited with interest.

ing of ectoderm cells into the region between the basal epithelium and the corium. From these cells are produced at first extremely minute horny rods, and these, later, together with their parent cells, sink through the corium into the position they finally occupy, where no one, not tracing their history in detail, would suspect their ectodermal origin. Even in Torpedo, where no horny rays occur in the paired fins of the adult ingrowths of ectoderm into the axial portions of the fin exist. At this point one author supports Rabl in his view that the unpaired fins are not derived from the fusion of paired rudiments. The opposite view is fastened upon Dohrn, regardless of the fact that it was first shown to be probable by J. K. Thacher and later supported by Balfour. Dohrn's special contention was that the fins, paired and unpaired, were derivatives of the parapodia of the worms, and later, Paul Mayer claimed to have found structures—" parapodoïds"—which reprepresented these. These "parapodoids" are, according to Klaatsch's view, the early placoid organs.

In studying the development of true bone, Klaatsch studied *Salmo salar*. Here the earliest to appear were the opercular bones, and but little later those of the shoulder girdle and those arising in connection with the teeth, later those of the cranium. The details of the formation of the scleroblasts for a few of these bones is given, including the squamosal, operculum, clavicula, dentary, and the osseous fin-rays. In the case of each, the osteoblasts are derivatives of the ectoderm. The squamosal is especially interesting, since it begins from outgrowths at the point of the infolding of the mucous canals, and is developed in connection with these organs. At first it is connected solely with them, and is plainly a membrane bone; later it comes into contact with the otic capsule. Klaatsch sides with those who would make no sharp distinction between cartilage- and membrane-bones, and regards not only the squamosal but the cranial roof and the ossifications which appear in the cranial roof and on the primordial cranium as having their origin in bones developed, like the squamosal, for protection of the cutaneous sense-organs.

After discussing these, Klaatsch passes to the bony fin-rays of the Teleosts and then to their scales, giving details which our space will not allow us to repeat, but in each case he comes back to the conclusion that in each and every case the so-called mesodermal element is of ectodermal origin. Then a few instances are taken from other groups—Salamandra and Lepus. In the Batrachia he finds the same conditions as in sharks and Teleosts. In the Mammals he fails to trace the history of his scleroblasts, but he finds here, as elsewhere, proliferations of ectodermal cells into the subadjacent tissues, which, it is possible, may later form the skeletogenous cells.

It needs hardly be said that these various contributions thus superficially summarized are most important, since, if they be confirmed, they will tend to an overthrow of many ideas long believed to be firmly grounded. The questions concerned are far from settled, but we venture to predict that the subject will occupy a prominent place in the morphological literature of the immediate future.

LITERATURE CITED.

'92. **N. Goronowitsch.** Die axiale und laterale Kopfmetamerie der Vogelembryonen. Anat. Anzeiger, VII.

'93. Untersuchungen über die Entwickelung der sog. Ganglienleisten der Vogelembryonen. Morph. Jahrbuch., XX.

'93ª. Weiteres über die ectodermale Entstehung von Skeletanlagen im Kopf der Wirbelthiern. Morph. Jahrb., XX.

'88. **N. Kastschenko.** Zur Entwicklungsgeschichte der Selachierembryo. Anat. Anz., iii.

'94. **H. Klaatsch.** Uber die Herkunft der Scleroblasten. Morph. Jahrb., XXI.

'93. **Julia B. Platt.** Ectodermic Origin of the Cartilages of the Head. Anat. Anz., VIII.

'93ª. Ontogenetic Differentiations of the Ectoderm of Necturus. Anat. Anz., IX.

VARIATION OF NORTH AMERICAN FISHES.*

I.

THE VARIATION OF ETHEOSTOMA CAPRODES RAFINESQUE.

BY W. J. MOENKHAUS.

Etheostoma is a genus of American Freshwater Percidæ. It consists of about 100 species distributed in a number of subgenera. All the members of the genus are small. They are distributed over approximately the entire Atlantic slope of North America. The northernmost points are Fort Quappelle and Montreal; the southernmost, Chihuahua. The most west ern points are Colorado and Swift Current in Canada near the 108th meridian.

The subgenus Percina includes the largest of the darters. There are but two well-defined species. One, *Etheostoma rex* is known from east of the Alleghany Mountains. The other, *Etheostoma caprodes* is also found east of the Alleghanies, but its chief habitat is west of these mountains, where it is found from Lakes Champlain and Superior to the Rio Grande.

This latter species, *Etheostoma caprodes* Rafinesque, has been studied with a view to ascertain the extent of its variation, the relation of its variation to its geographical distribution, the extent of variation in each locality, and the variation with age. This species of the darters has been selected for its size, and on account of its wide distribution and moderate abundance within its limits. Its variability has been known for a long time, and has given it a number of specific names.

The material examined is recorded in the table of measurements and counts.

The greatest variation was found to be in the color. Slighter, variations were found in proportions and number of fin rays.

---

* Contributions from the Zoological Laboratory of Indiana University, under the direction of Carl H. Eigenmann, No. 10.

Evolution of the Color Pattern.

As just stated, the point of greatest variability is the color pattern. The colors in life are not taken into consideration, but only the black markings which were preserved in alcoholic specimens. On comparing living specimens with alcoholic material, but little difference was noticed. In the matter of color patterns, the specimens from any one locality agree to a remarkable extent. This statement refers only to specimens of the same size—differences, of course, existing between young and adult stages.

The simplest pattern was found in specimens from Chocola Cr., Ala. These were immature specimens, and do not represent the adult condition.

In these specimens (30 and 33 mm. long., fig. 1), we have a series of nine cross-bars extending from the back to below the middle of the sides. The bars at the ends of the dorsal fins are much emphasized, and all the bars are heaviest at their upper and lower ends. There is a distinct round spot at the root of the caudal. The color of the head need not be taken into consideration in this specimen. The caudal spot remains in all the specimens examined. The most complicated pattern, that of fig. 7, is shown to be derived by easy stages and step by step from the condition figured in fig. 1.

The simplest pattern in adult fishes is found in specimens inhabiting the waters of the Wabash River and its tributaries in Indiana (Nos. 9, 40 and 44). The pattern here consists of a series of long and short bars alternating. In the anterior region, the short bars are usually as long as the long bars. A better way to designate these is to term the long bars "whole bars," and the short bars "half bars." The whole bars towards the posterior end of the body spread slightly and become more intensely colored toward their ventral extremity. The black caudal spot is also present here. This spot does not vary in any of the patterns figured. The head is colored black above, and has a large spot on the opercle, taking the general form of the opercle itself. The color on the top of the head is most intense towards the posterior, as shown in fig. 9, and becomes less less distinct as it extends forward to the tip of the snout.

Around the eyes are seen faint indications of three bars: one extending forward; the second downward, and the third backward (fig. 2).

Comparing this pattern with the one in the young, we find that the whole bars are homologous in the two, and that the half bars have been added.

A step in advance is taken by the adult specimens from Chocola Cr., Ala., fig. 3 (Nos. 76–82). These have the bars alternately long and short along the entire length of the body. The bars are considerably broader and more intense, and the whole bars have their ventral extremities much broadened, so as to form quite an apparent series of spots along the side. An additional half bar is added by the union of the spot above and the spot just in front of the black caudal spot. Here the three bars radiating from the eye are somewhat more distinct than in the pattern already described.

The next series of individuals are Nos. 45–55, 72, 73 and 75, in the list given below, and are represented by fig. 4. They are found in the Green, Cumberland, Tennessee and Arkansas River Basins. The color pattern here shows a greater irregularity in its bars, and has developed in addition a still shorter between each of the whole and half bars of the preceding pattern, so that we have. now whole, half and quarter bars. The series of lateral spots is present only along a part of the body. The bar extending anteriorly from the eye is broken into two shorter and less distinct ones.

Of considerable significance in the specimen figured in fig. 3 is the fact that in the bar between the dorsals, we have a notch indicating that some of the color-cells are separating from the whole bar. A similar condition is shown in the same region of fig. 4. The quarter bars are apparently split off from the other bars. It is of interest that variations in the direction of an increased number of bars is always, as far as my specimens go, introduced at this point. Specimens intermediate between this and the preceding form show that the quarter bars always make their first appearance between the seventh and eighth whole bars and the included half bar.

Other quarter bars are then added in front and behind this region.

From the conditions represented in fig. 3, we have two diverging lines of development. The one line was discussed in the preceding paragraph. The other line is found in specimens, Nos. 82 and 83, taken from San Marcos Spring, Texas, and is represented in fig. 5. We have here a splitting of the bars without the regular result seen in fig. 4. The lower ends of the whole bars have not split, in fact, they have increased in width, and form a very prominent series of spots along the side. It will be seen that the bars radiating from the eye have become much more pronounced.

The pattern of fig. 6 can be easily derived from the preceding one by assuming that the lower half of the whole bars of the anterior part of the body have shifted their position backward, so that they no longer extend extirely to the mid-dorsal line. The 3d, 4th and 5th whole bars show different degrees of shifting. The lower part of the 4th has shifted, but still retains its connection with the upper part. In the 3d, the bar is more nearly separated, while in the 5th the separation is complete, and the original lower part of the bar becomes simply a vertically elongated spot. The bars around the eye are here again less developed. The pattern of fig. 6 is the one occurring in *Etheostoma caprodes manitou* Jordan, and was drawn from a specimen taken from Torch Lake, Mich. Other specimens, taken from the same lake and from other localities, have the same color pattern with slight variations. Nos. 1–7, and 41 of Table I, are this variety.

The line of development taken up by fig. 5 is continued in figs. 7 and 8, representing the specimens from Obey's River and Eagle Creek in Tennessee, and from the Little South Fork of the Cumberland River in Kentucky. These are Nos. 56–72 in the table. A single young specimen, No. 74, which promised to become this form, was also taken in the North Fork of the Holston River, in Virginia. The two figures were drawn from a younger and older specimen respectively, of the same form. In the younger specimens, the bars have become more split up, and have increased in irregularity. Almost all of

the original bars, however, can be traced. The lateral spots, too, are much more prominent than in the preceding pattern. In the older individuals the bars have become so much split up as to form a complicated network, and the original pattern can be made out only in a general way. The spots are larger and darker than in the younger, and form almost a continuous lateral band. The radiating bars around the eyes are correspondingly more developed, the one extending backward in a slight curve beyond the head to the first lateral spot.

In the last pattern, the original simple whole and half bars have reached their greatest modification, and the faint lateral spots of fig. 2 have become the most prominent part of the coloration.

The variation presents a serial modification in two divergent lines from an original simplest pattern. Beginning with the whole bars of fig. 1, we pass to the form having alternate whole and half bars, and an imperfect series of lateral spots. From this form we pass on the one hand to the pattern having alternate whole, half and quarter bars, and on the other hand to the pattern consisting of reticulated markings above, and a very prominent series of spots along the sides. In the pattern of fig. 6, we have a second divergent line of development from fig. 5. The radiating bars around the eyes become more developed as we pass from the simple to the more complex patterns, with the exception in fig. 6.

It will be seen from the localities at which each of the various patterns occurred, that there is no definite serial relation between the variations and the latitude at which they are found. As already stated, however, the variations are remarkably definite for a given locality. The specimens from the Wabash waters can, almost without exception, be distinguished from those of the Cumberland River, for instance, while those from the Alabama River are distinguished by their invariably broader bars. Both the patterns of figs. 4 and 6 occur in the Cumberland and Tennessee River system, but both have not been taken from the same tributaries of these streams.

The color pattern of *Etheostoma caprodes* is of interest when considered as to its bilateral symmetry. In most of the sim-

plest patterns, the corresponding bars on the two sides are exactly alike, and precisely meet each other in the mid-dorsal tine. This almost perfect symmetry is not so prevalent in the more complex patterns. The simplest cases of asymmetry are found in the simplest patterns when some of the bars do not exactly meet their fellows on the back. Fig. 8 shows an instance of this kind. Both the asymmetrical and the symmetrical forms occur in the same locality, and the former seems purely accidental, but in all cases observed, it makes its first appearance in the bars along the spinous dorsal. From this point it spreads backward along the soft dorsal until we reach an extreme form of asymmetry, as represented in fig. 9. Here the first three and the last four bars, together with the bar between the dorsals, still preserve their symmetry, while those along the entire length of both dorsals are quite asymmetrical.

In regard to variations in parts other than in the color pattern, only those points of structure were examined that could be most accurately made out on alcoholic specimens. One very marked departure from the regular form exists in the specimens from San Marcos Spr., Texas. This departure consists, as shown in fig. 5, of an increase in the depth of the body in the region of the spinous dorsal, as a result of the unusual elevation of the back in this region. These belong to the variety carbonaria, described from Texa, and are more distinct in points of form than the varieties I examined from any other locality.

No. 8 in Table I, taken by Dr. Meek at Cedar Rapids, Iowa, differs materially from any of the specimens from other localities. It approaches nearest the variety zebra in the color pattern, and in having no scales before the spinous dorsal. The scales, however, are larger, there being but 76 in the lateral line. The head measures 3½ in body and the number of rays in anal is 12.

The following table will give the number of specimens, their locality and the points of structure which have been examined. The spines in the dorsal and anal fins are indicated by Roman numbers and the rays by Arabic numbers. The length of the

specimens are measured in mm. from the tip of the snout to root of caudal. Only those scales of the lateral line are counted which have the tubes developed in them. The localities are arranged in the order of their latitude from north to south.

TABLE I.

LOCALITY.	Figures representing these types.	Length of body in mm.	Length of head in mm.	Head in body.	Dorsal fin.	Anal fin.	Scales in lateral line.
1. Torch Lake, Mich.	6	77	19	$4\frac{1}{19}$	XIV,15	II,10	90
2. " " "	6	76	19	4	XIV,15	II,10	90
3. " " "	6	80	20	4	XV,15	II,10	85
4. " " "	6	75	$18\frac{1}{2}$	$4\frac{1}{18}$	XV,15	II,10	89
5. " " "	6	80	20	4	XV,15	II,10	90
6. " " "	6	77	19	$4\frac{1}{19}$	XIV,14	II,10	90
7. " " "	6	73	18	$4\frac{1}{18}$	XV,16	II,11	90
8. Cedar Rapids, Iowa	6	70	20	$3\frac{1}{2}$	XIV,15	II,12	76
9. White River, Indianapolis, Ind.	2				XIV,16	II,10	86
10. Racoon Creek, Mecca, Ind.	2	40	$10\frac{3}{4}$	$3\frac{9}{10}$			89
11. " " " "	2	42	11	$3\frac{9}{11}$			90
12. " " " "	2	41	11	$3\frac{8}{11}$			90
13. Gosport, Ind.	2	90	21	$4\frac{2}{7}$	XV,15	II,10	90
14. " "	2	50	13	$3\frac{11}{13}$	XIV,15	II,10	88
15. " "	2	38	10	$3\frac{4}{5}$	XV,15	II,10	90
16. " "	2	47	13	$3\frac{8}{13}$	XV,15	II,10	87
17. " "	2	53	14	$3\frac{11}{14}$	XV,15	II,10	90
18. Bean Blossom, Ind.	2	67	17	$3\frac{16}{17}$	XV,16	II,10	87
19. " " "	2	84	22	$3\frac{4}{11}$	XIV,16	II,11	90
20. " " "	2	94	24	$3\frac{11}{12}$	XIV,17	II,11	88
21. " " "	2	$86\frac{1}{2}$	$22\frac{1}{2}$	$3\frac{9}{22}$	XV,16	II,11	85
22. " " "	2	83	21	$3\frac{20}{21}$	XIV,16	II,11	86
23. " " "	2	113	27	$4\frac{5}{27}$	XV,15	II,11	86
24. " " "	2	$71\frac{1}{2}$	$18\frac{1}{2}$	$3\frac{17}{18}$	XIV,16	II,10	88
25. " " "	2	82	$21\frac{1}{2}$	$3\frac{16}{21}$	XIV,16	II,10	87
26. " " "	2	77	21	$3\frac{2}{3}$	XV,16	II,11	88
27. " " "	2	71	18	$3\frac{5}{6}$	XIV,16	II,11	88
28. " " "	2	61	16	$3\frac{3}{4}$	XV,16	II,10	87
29. " " "	2	44	11	4	XIV,16	II,11	85
30. " " "	2	42	11	$3\frac{9}{11}$	XV,16	II,10	86
31. " " "	2	47	13	$3\frac{8}{13}$	XIII,16	II,10	85
32. " " "	2	96	24	4	XV,15	II,11	88
33. " " "	2	73	18	$4\frac{1}{18}$	XIV,16	II,10	85
34. " " "	2	68	17	4	XIV,16	II,10	86
35. " " "	2	35	10	$3\frac{1}{2}$			
36. " " "	2	33	9	$3\frac{2}{3}$			
37. Rushville, Ind.	2	88	22	4	XIV,15	II,10	90
38. Wild Cat Creek, Kokomo, Ind.	2	130	32	$4\frac{1}{16}$	XV,16	II,11	85

	Locality.	Figures representing these types.	Length of body in mm.	Length of head in mm.	Head in body.	Dorsal fin.	Anal fin.	Scales in lateral line.
39.	Pike Creek, Ind.	2	107	26	$4\frac{3}{26}$	XIV,16	II,11	89
40.	" " "	2	102	25	$4\frac{2}{25}$	XV,16	II,11	91
41.	Illinois	2	65	15	$4\frac{1}{3}$	XV,14	II,10	89
42.	Nipisink Lake, Ills.	2				XV,15	II,10	85
43.	" " "	2				XIV,15	II,11	85
44.	Monongahela River, Pa.	4	96	23	$4\frac{2}{23}$	XV,15	II,10	85
45.	Hartford, Ky.	4	76	19	4	XVI,14	II,10	88
46.	" "	4	76	19	4	XV,15	II,10	87
47.	" "	4	76	19	4	XIV,16	II,10	88
48.	" "	4	78	19½	4	XV,16	II,11	90
49.	Green River, Greensburg, Ky.	4	85	20	$4\frac{5}{20}$	XV,15	II,10	89
50.	" " " "	4	90	21½	$4\frac{4}{21}$	XV,16	II.11	92
51.	" " " " "	4	77	17½	$4\frac{7}{17}$	XV,15	II,11	85
52.	Little Barren River, Osceola, Ky.	4	92	23	4	XV,15	II,11	89
53.	" " " " "	4	69	17	$4\frac{1}{17}$	XV,14	II,11	89
54.	" " " " "	4	69	17	$4\frac{1}{17}$	XVI,15	II,11	89
55.	" " " " "	4	69	17	$4\frac{1}{17}$	XIV,16	II,11	83
56.	Little S. Fork Cumberland River, Wayne Co., Ky.	7 & 8	103	25	$4\frac{1}{8}$	XVI,15	II,11	92
57.	Eagle Creek, Olympus, Tenn.	7 & 8	82	21	$3\frac{19}{21}$	XVII,14	II,11	87
58.	" " " "	7 & 8	61½	16	$3\frac{13}{16}$	XVI,15	II,11	92
59.	Obey's River, " "	7 & 8	77	18	$4\frac{5}{18}$	XVII,14	II,11	89
60.	" " " "	7 & 8	86	21	$4\frac{2}{21}$	XV,14	II,10	86
61.	" " " "	7 & 8	55	13½	$4\frac{1}{13}$	XVI,15	II,12	89
62.	" " " "	7 & 8	66	17	$3\frac{15}{17}$	XVI,15	II,12	90
63.	" " " "	7 & 8	62	15	$4\frac{2}{15}$	XVII,15	II,12	87
64.	" " " "	7 & 8				XVII.15	II,11	90
65.	" " " "	7 & 8	65	16½	$3\frac{15}{16}$	XV,17	II,11	90
66.	" " " "	7 & 8	53	14	$3\frac{11}{14}$	XVI,15	II,11	89
67.	" " " "	7 & 8	54	13½	4	XVII,15	II,12	86
68.	" " " "	7 & 8	60	15	4	XVII,15	II,12	91
69.	" " " "	7 & 8	51½	12½	$4\frac{1}{12}$	XVII,14	II,12	85
70.	" " " "	7 & 8	53½	13	$4\frac{1}{13}$	XVII,15	II,12	89
71.	" " " "	7 & 8	57½	14½	4	XVII,15	II,11	90
72.	Watauga River, Elizabethtown, Tenn.	4	122	27		XVI,16	II,11	92
73.	" " "	4	94	21		XV,16	II,10	92
74.	North Fork Holston River, Saltville, Va.	7 & 8	47½	13	$3\frac{9}{13}$	XVI,15	II,12	92
75.	Eureka Springs, Ark.	4	112	24	$4\frac{2}{3}$	XVI,15		
76.	Chocola Creek, Oxford, Ala.	3	94	21	$4\frac{10}{21}$	XVI,15	II,11	91
77.	" " " "	3	97	18	$4\frac{5}{18}$	XV,17	II,12	78
78.	" " " "	3	89	21	$4\frac{5}{21}$	XVI,17	II,11	93
79.	" " " "	3	78	17	$4\frac{10}{17}$	XV,15	II,11	90
80.	San Marcos Spring, Texas	5	95	21	$4\frac{11}{21}$	XIII,15	II,11	85
81.	" " " " "	5	102	24	$4\frac{1}{4}$	XIV,15	II,11	93
82.	" " " " "	3	27	7	$3\frac{6}{7}$			
83.	" " " " "	3	30	8	$3\frac{3}{4}$			

Table II presents all the combinations of dorsal spines and dorsal rays, and the number of specimens having the given combination. (But 76 of the specimens have been examined for this table.) The combinations are arranged in the numerical order of the spines from the lowest number to the highest. In the third column are given the per cents. of specimens having each combination. XV, 15 is seen to be the commonest combination; XIV, 16 the next, XV, 16 and XVI, 15 the next, and so on. The largest per cent. of any combination does not exceed 21.052.

TABLE II.

Dorsal Fins.	Number of specimens.	er cent. of specimens.
XIII, 15	1	1.315
XIII, 16	1	1.315
XIV, 14	2	2.631
XIV, 15	6	7.895
XIV, 16	12	15.789
XIV, 17	1	1.315
XV, 14	3	3.947
XV, 15	16	21.05
XV, 16	11	14.47
XV, 17	2	2.631
XVI, 14	1	1.315
XVI, 15	9	11.841
XVI, 16	1	1.315
XVI, 17	1	1.315
XVII, 14	3	3.947
XVII, 15	6	7.894

In Table III are arranged the varieties in the number of dorsal spines, the number of specimens representing each variation, and the per cent, of all the specimens for each variation. The average number of spines is $15\frac{5}{76}$, while the number of spines predominating is 15.

TABLE III.

DORSAL SPINES.	Number of specimens.	Per cent. of specimens.
XIII	2	2.631
XIV	21	27.63
XV	32	42.11
XVI	12	15.789
XVII	9	11.841
Average number of spines		$15\frac{5}{76}$

In Table IV the same data are given for the dorsal rays. The average number of rays is $15\frac{6}{19}$, about the same as the spines. Fifteen is seen to be the number in about 50 per cent. of all the specimens examined. While 42.11 per cent. have fifteen dorsal spines, and 50.007 per cent. have fifteen dorsal rays, only 21.05 per cent. have a combination of fifteen spines and fifteen rays.

TABLE IV.

DORSAL RAYS.	Number of specimens.	Per cent. of specimens.
14	9	11.841
15	38	50.007
16	25	32.90
17	4	5.262
Average number of rays		$15\frac{6}{19}$

The variations in the anal fin are given in Table V. The anal fins of only 76 specimens were examined.

PLATE XVIII.

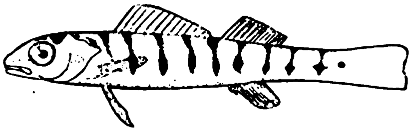


FIG. 1.

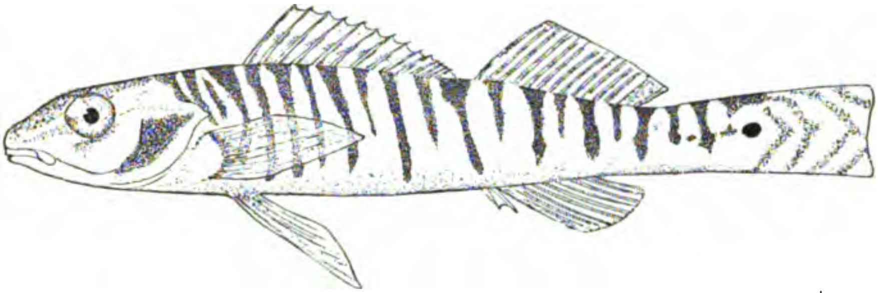


FIG. 2.

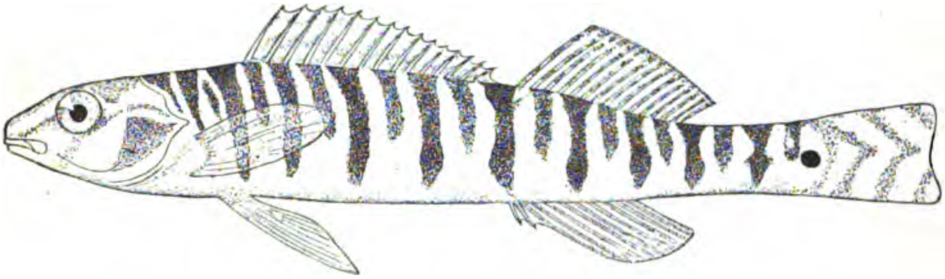


FIG. 3.

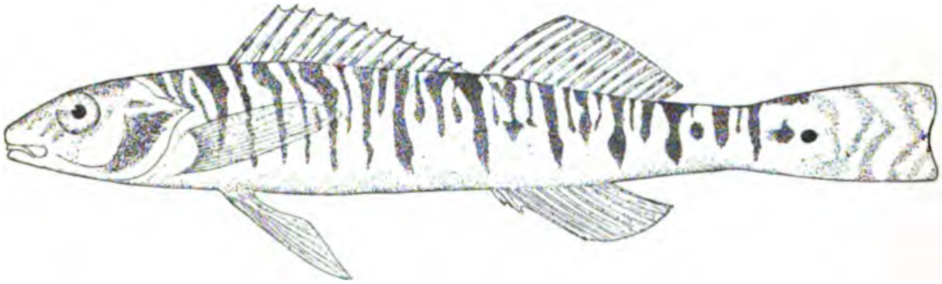


FIG. 4.

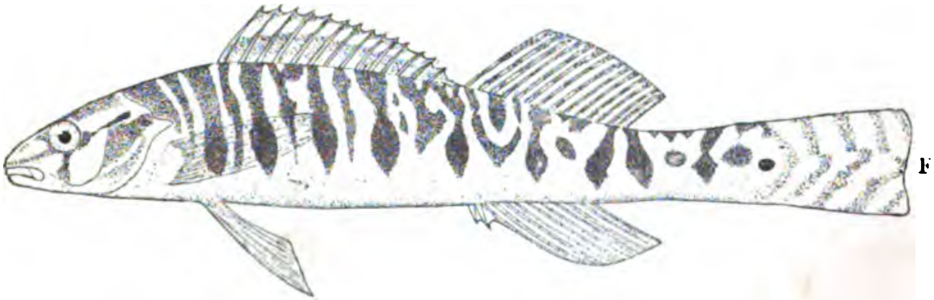


FIG. 5.

Etheostoma caprodes, Raf.

PLATE XIX.

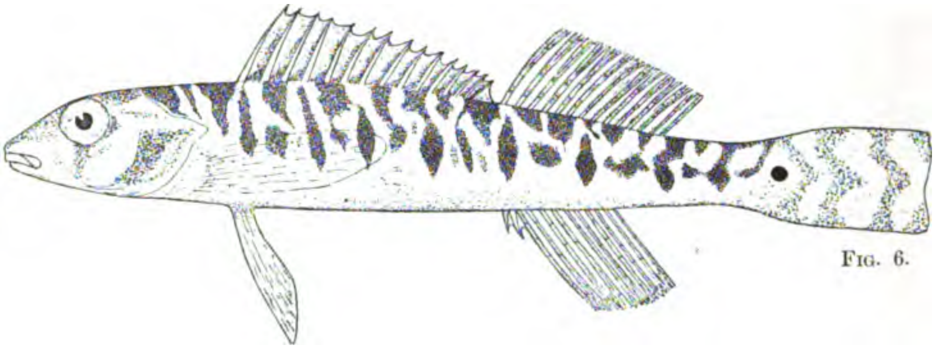


FIG. 6.

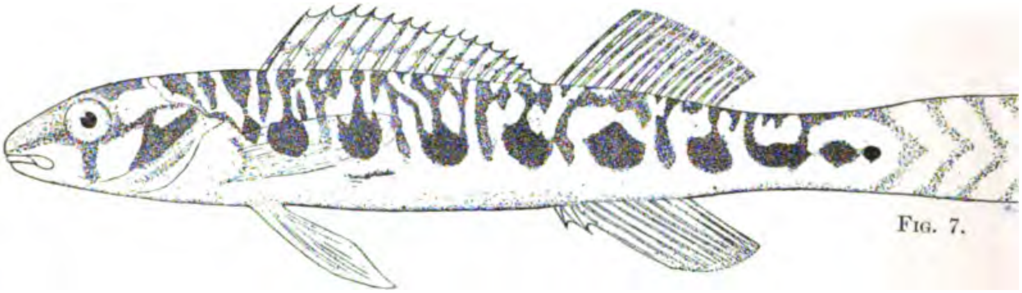


FIG. 7.

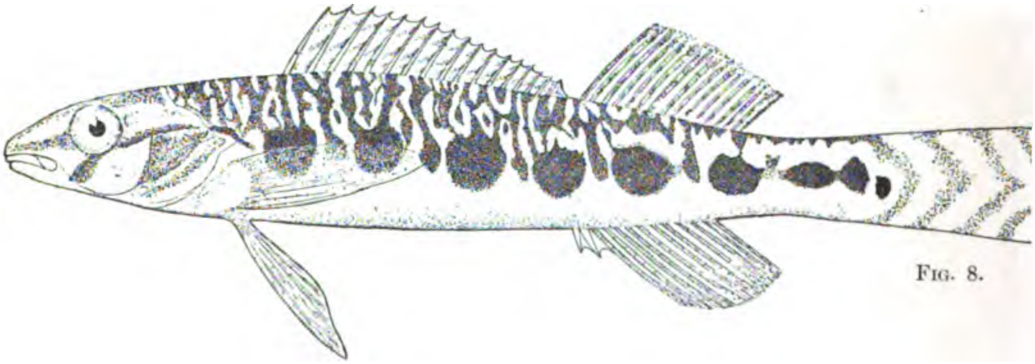


FIG. 8.

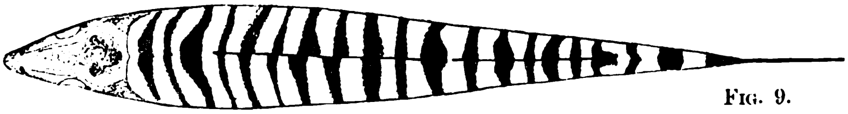


FIG. 9.

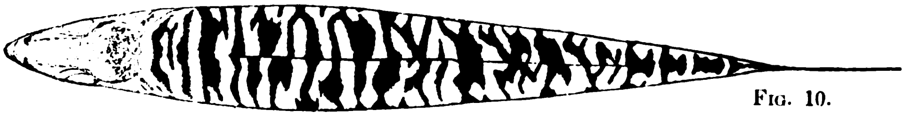
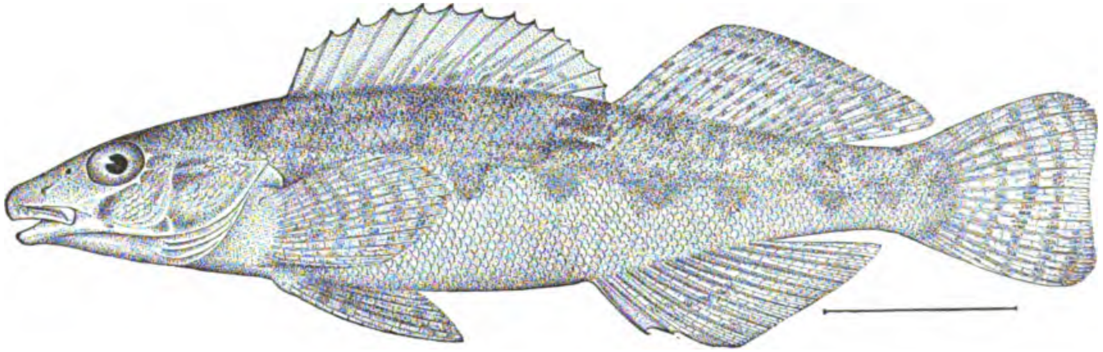


FIG. 10.

Etheostoma caprodes, Raf.

PLATE XX.



. *Etheostoma rex*, Jordan.

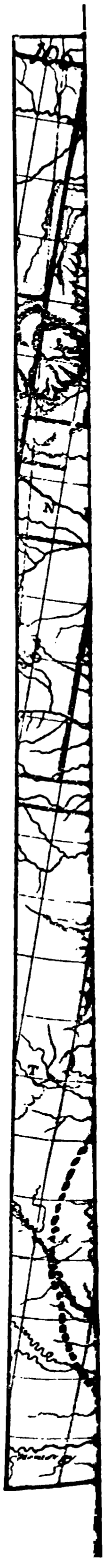

106
N
T

TABLE V.

ANAL FINS.	Number of specimens.	Per cent. of specimens.
II, 10	30	39.47
II, 11	36	47.37
II, 12	10	13.15
Average number of anal rays		10 14/19

In Table VI are given the variations in the number of scales in the lateral line. The scales were counted on 79 specimens. Eighty-five was the number found in a number having the lateral line incompletely developed. Eighty-five, eighty-eight, eighty-nine and ninety were found in about 60 per cent. of the specimens examined.

TABLE VI.

SCALES WITH PORES.	Per cent. of specimens.	Number of specimens.
76	1	1.265
78	1	1.265
83	1	1.265
85	12	15.20
86	7	8.86
87	7	8.86
88	8	10.12
89	12	15.20
90	18	22.77
91	3	3.80
92	7	8.86
93	2	2.53
Average number of scales		88 11/79

Table VII indicates the number of specimens, the average number of dorsal spines, and the number of specimens with thirteen, fourteen, fifteen, sixteen and seventeen spines from each of the localities from which specimens were examined. The localities are arranged as they occur, from north to south. It will be seen that the prevailing numbers occurring in the more northern streams are fourteen and fifteen. As we go farther south the usual number is fifteen and sixteen, and in the most southern streams the numbers are fifteen, sixteen and seventeen spines, the specimens from Texas are peculiarly poor in the number of spines.

TABLE VII.

LOCALITY.	Number of specimens.	Average number of dorsal spines.	Number of specimens with 13.	Number of specimens with 14.	Number of specimens with 15.	Number of specimens with 16.	Number of specimens with 17.
Torch Lake, Mich	7	14$\frac{4}{7}$		3	4		
Cedar Rapids, Ia	1	14		1			
White River, at Indianapolis	1	14		1			
Gosport, Ind	5	14$\frac{4}{5}$		1	4		
Bean Blossom, Ind	17	14$\frac{6}{17}$	1	9	7		
Rushville, Ind	1	14		1			
Wild Cat Creek, Ind	1	15			1		
Pike Creek, Ind	2	14$\frac{1}{2}$		1	1		
Illinois	1	15			1		
Nipisink Lake, Ill	2	14$\frac{1}{2}$		1	1		
Monongahela River	1	15			1		
Hartford, Ky	4	15		1	2	1	
Green River, Greensburg, Ky	3	15			3		
Little Barren River, Osceola, Ky	4	15		1	2	1	
Little South Fork Cumberland River, Wayne Co., Ky	1	16				1	
Eagle Creek, Olympus, Tenn	2	16$\frac{1}{2}$				1	1
Obeys River, Elizabethtown, Tenn	13	16$\frac{6}{13}$			2	3	8
Watauga River, " "	2	15$\frac{1}{2}$			1	1	
North Fork Holsten River, Saltville, Va.	1	16				1	
Eureka Springs, Ark	1	16				1	
Chocola Creek, Oxford, Ala	4	15$\frac{1}{2}$			2	2	
San Marcos Springs, Tex	2	13$\frac{1}{2}$	1	1			

Table VIII contains the same data with regard to the dorsal rays. In the last column is given the average number of dorsal spines and rays combined. The rays do not show the same variation found in the dorsal spines, the number being the same for localities north and south. The average number of dorsal spines and rays combined consequently increases with the dorsal spines.

TABLE VIII.

LOCALITY.	Number of specimens.	Average number of dorsal rays.	Number of specimens with 13.	Number of specimens with 14.	Number of specimens with 15.	Number of specimens with 16.	Number of specimens with 17.	Av. num. of dorsal rays & spines.
Torch Lake	7	15		1	5	1		29 4/7
Cedar Rapids, Ia.	1	15			1			29
White River, at Indianapolis	1	16				1		30
Gosport, Ind.	5	15			5			29 4/5
Bean Blossom, Ind	17	15 16/17			2	14	1	30 5/17
Rushville, Ind	1	15			1			29
Wild Cat Creek, Ind.	1	16				1		31
Pike Creek, Ind	2	16				2		30 1/2
Illinois	1	14		1				29
Nipisink Lake, Ill	2	15			2			29 1/2
Monongahela River	1	15			1			30
Hartford, Ky	4	15 1/4		1	1	2		30 1/4
Green River, Greensburg, Ky	3	15 1/3			2	1		30 1/3
Little Barren River, Osceola, Ky	4	15		1	2	1		30
Little South Fork Cumberland River, Wayne Co., Ky	1	15			1			31
Eagle Creek, Olympus, Tenn.	2	14 1/2		1	1			31
Obeys River, Elizabethtown, Tenn	13	14 12/13		3	9		1	31 5/13
Watauga River, " "	2	16				2		31 1/2
North Fork Holston River, Saltville, Va	1	15			1			31
Eureka Springs, Ark	1	15			1			31
Chocola Creek, Oxford, Ala	4	16			2		2	31 1/2
San Marcos Spring, Tex	2	15			2			28 1/2

Table IX gives similar data on the anal fins. The spines are not given since they were found to be two in all cases examined. In the anal rays we have, as in the dorsal spines, a slight increase in their number from north to south. The

most common number in the Indiana streams is ten, the number increasing to eleven and twelve in the most southern specimens.

TABLE IX.

LOCALITY.	Number of specimens.	Average number of anal rays.	Number of specimens with 10 rays	Number of specimens with 11 rays	Number of specimens with 12 rays
Torch Lake	7	$10\frac{1}{7}$	6	1	
Cedar Rapids, Ia	1	12			1
White River, at Indianapolis	1	10	1		
Gosport, Ind	5	10	5		
Bean Blossom, Ind	17	$10\frac{9}{17}$	8	9	
Rushville, Ind	1	10	1		
Wild Cat Creek, Ind	1	11		1	
Pike Creek, Ind	2	11		2	
Illinois	1	10	1		
Nipisink Lake, Ill	2	$10\frac{1}{2}$	1	1	
Monongahela River	1	10	1		
Hartford, Ky	4	$10\frac{1}{4}$	3	1	
Green River, Greensburg, Ky	3	$10\frac{2}{3}$	1	2	
Little Barren River, Osceola, Ky	4	11		4	
Little South Fork Cumberland R., Wayne Co., Ky.	1	11		1	
Eagle Creek, Olympus, Tenn	2	11		2	
Obeys River, Elizabethtown, Tenn	13	$11\frac{6}{13}$	1	5	7
Watauga River, " "	2	$10\frac{1}{2}$	1	1	
North Fork Holston River, Saltville, Va	1	12			1
Eureka Springs, Ark	1				
Chocola Creek, Oxford, Ala	4	$11\frac{1}{4}$		3	1
San Marcos Springs, Tex	2	11		2	

SYNONYMY, BIBLIOGRAPHY AND DISTRIBUTION OF ETHEOSTOMA CAPRODES RAFINESQUE.

Sciæna caprodes Rafinesque, "Amer. Month. Mag., 1818, 534."

Etheostoma caprodes Raf., "Ich. Oh., 1820, 38." Kirtland, Zool, Ohio, 1838, 168, 192; Bost. Jour, Nat. Hist., III, 346, 1841. (Ohio); Storer, "Synop. Fish. N. A., 1847, 270–272." Evermann, Bull. No. 2. Brookville Soc. Nat. Hist., 1886, 8. (Little Cedar Cr., Ind.); Evermann & Bollman, Notes on Coll.

Fish. from Monongahela R., 1886; Jenkins, Proc. Terre Haute Sci. Soc., 1886. (Streams of Vigo Co., Ind.); Evermann & Jenkins, Proc. U. S. Nat. Mus., 1888, 51–57. (Tippecanoe R., Wabash R., Deer Cr., Little Deer Cr., Wild Cat Cr., Fourteen Mile Cr., Clarke Co., Ind.); Meek, Proc. U. S. Nat. Mus., XI, 1888, 440. (Maumee R., Defiance Co., O.); Jordan, Bull. U. S. Fish Com., 1888, 147, 153, 159, 164, 167. (White R., at Spencer, Ind.); Mackey's Ferry, Posey Co., Ind; Wabash R., Vincennes, Ind.; Patoka R., at Patoka, Gibson Co., Ind.; Black R., New Harmony, Ind.; Wabash R., at New Harmony, Ind.; Eel River, Logansport, Ind.; Swannanoa R., at Asheville, N. C.; Watauga R., Elizabethton, Tenn.; North Fork of Holston R., (near Glade Spr.,Va.); Bollman, Bull. U. S. Fish Com., 1888, 224. (Cognac and Torch Lakes, Mich.; Spencer Cr., Calhoun Co., Mich.); Henshall, Journ. Cin. Soc. Nat. Hist., 1888, 80. (Little Miami R., and Ross L., O.); Meek, Bull. U. S. Fish Com., IX, 1889, 123, 128, 130, 139. (Gasconade R., at Arlington, Mo.; Spadra Cr., at Clarkesville, Ark.; James R., near Springfield, Mo.); Gilbert, Bull. U. S. Fish Com., 1889, 151, 155. (Ala. R., Tenn. R.); Jordan, Bull. U. S. Fish Com., 1889, 18. (Arkansas R., at Wichita); Jordan, Man. Vert., 1890, 126. (Gr. Lakes to Va., Ala. and Texas); Kirsch, Bull. U. S. Fish Com., 1891, 260, 261, 262, 264, 265, 266, 268. (Southern Trib. Cumb. R. in Tenn. and Ky.); McCormick, Lab. Bull. No. 2, Oberlin College, O., 1892. (Waters of Loraine Co., O.); Evermann & Kendall, Bull. U. S. Fish Com., 1894, 84, 88, 93, 113, pl. XXXV. (Long L., near Magnolia Point; Nechec R., east of Palestine.)

Pileoma caprodes Agassiz, L. Superior, 1850, 308; Le Vaillant, "Recherches sur les Poissons, etc., 1873."

Percina caprodes Girard. "Proc. Acad. Nat. Sci., Phila., 1859, 66;" Putnam, "Bull. M. C. Z., 1863, 5;" Cope, Proc. Acad. Nat. Sci., Phila., 1865, 82; Cope, Journ. Acad. Nat. Sci,, Phila., 1869, 211; Jordan, Ind. Geol. Sur., 1874, 213; Man. Vert., 1876, 224; Bull. Buffalo Soc. Nat. Hist., 1876, 93; Jordan & Copeland, Am. Nat., 1876, 337; Bull. Buffalo Soc. Nat. Hist., 1876, 135; Jordan, Proc. Acad. Nat. Sci., Phila., 1877, 44, 53, 54. (Low. Wabash R., White R.); Jordan, Ann. N. Y. Lyc. Nat. Hist.,

1877, 312, 373, 376. (Etowah, Oostanaula and Coosa Rivers, Ga.; Rock Castle R., S. E. Ky.; White R., at Indianapolis); Jordan, Bull. U. S. Nat. Mus. No. 9, 1877, 15, 24. (Notes on Nomenclature); Jordan, Bull. U. S. Nat. Mus. No. 10, 1877, 15. (Gr. Lake Region to Alabama); Jordan & Brayton, Bull. U. S. Nat. Mus. No. 12, 1878, 45, 57, 73. (Ala. R., Tenn. R., Cumb. R.); Jordan, Bull. 2 Ills. State Lab. Nat. Hist., 1878, 3. (Vermilion R., Calumet R., Wabash R., Pine Cr., Mo.); Jordan, Geo. Surv. of Ohio, IV, 1878, 970. (Quebec to Georgia, Lake Superior, and the Rio Grande); Jordan, Bull. U. S. Geo. Surv., 1879, 438. (Gr. Lake Region to Ala.); Hay, Proc. U. S. Nat. Mus., III, 1880, 491. (Chickasawha R., Miss.); Bean, Proc. U. S. Nat. Mus., III, 1880, 100. (Meadville, Penn., Racine, Wis., Columbus, O., Westport, N. Y., Poland, O., Yellow Cr., O., Madrid, N. Y., Ohio, Potomac R., Penn.); Cope, Report of State Fish Com. Pa., 124. (Lake Erie and Allegheny R., east to Lake Champlain); Hay, Bull. U. S. Fish Com., II, 1882, 60. (Vicksburg and Jackson, Miss.); Jordan & Gilbert, Syn. Fish North America, 499, 1883. (Gr. Lakes and streams of the South and West); Forbes, Rept. Ills. State Fish Com., 1884, 65. (L. Mich. to Cairo and Wabash Valley); Gilbert, Proc. U. S. Nat. Mus., VII, 1884, 204. (Salt Cr., near Bedford, Ind.); Jordan, Ann. Rept. Com. Fish and Fisheries, 1884, 79; Eigenmann & Fordice, Proc. Acad. Nat. Sci., Phila., 1885, 411. (Bean Blossom Cr., Ind.); Jordan & Eigenmann, Proc. U. S. Nat. Mus., 1885, 68; Jordan & Gilbert, Proc. U. S. Nat. Mus., 1886, 5, 8, 13, 21. (White R., near Eureka Springs; Trib. of Ark. R., near Ft. Smith; Washita R., at Arkadelphia, and Saline R., at Benton, Ark.; Rio San Marcos, at San Marcos, Tex.; Colorado R., at Austin, Tex.); Gilbert, 3d Series of Notes on Kansas Fish, ed. 1887, 207. (Inokomo Cr., Kans.)

Percina nebulosa Haldeman, "Journ. Acad. Nat. Sci., Phila., VIII, 1842, 330;" Girard, Proc. Acad. Nat. Sci., Phila., 1859, 66.

Perca nebulosa DeKay, "Fishes of N. Y., 1842, 7."

Etheostoma nebulosa Storer, "Synop. Fish N. A., 1847, 270–272."

Pileoma semifasciatum DeKay, N. Y. Fauna Fish., 1842, pl. 50, 162; Günther, I, 76, 1859. (Lake Erie and Ohio.)

Etheostoma semifasciata Storer, "Synop. Fish N. A., 1847, 270–272."

Percina semifasciata Girard, Proc. Acad. Nat. Sci., Phila., 1859, 66; Gill, Proc. Acad. Nat. Sci, Phila.. 1860, 20.

Pileoma carbonaria Baird & Girard, "Proc. Acad. Nat. Sci., Phila.," 1853, 387; Girard, U. S. and Mex. Bound. Surv., 10, 1859, pl. VIII, fig. 10–13. Rio Salado, Rio Medina, San Pedro Cr., Tex.); Günther, I, 76, 1859. (Rio Salado, Tex.)

Percina carbonaria Girard, "Proc. Acad. Nat. Sci., Phila., 1859, 67;" Jordan, Proc. Acad. Nat. Sci., Phila., 1877, 54. (Alabama R.); Jordan, Bull. U. S. Nat. Mus. No. 10, 1878, 15. (Texas); Jordan, Ann. N. Y. Lyc. Nat. Hist., 1878, XI, 312. (Alabama R.); Jordan, Bull. U. S. Geo. Surv., 1879, 438. (Texas).

Percina caprodes carbonaria Cope, Bull. 17, U. S. Nat. Mus., 1880, 31. (Trinity R., near Dallas, and Llano R., Kimble Co., Tex.)

Percina bimaculata Haldeman, "Proc. Bost. Soc. Nat. Hist., 1843, 157."

Etheostoma bimaculata Storer, "Synop. Fish N. A., 270–272, 1847."

Pileoma zebra Agassiz, Lake Superior, 308, pl. 4, fig. 4, 1850. (Lake Superior.)

Percina zebra Girard, Proc. Acad. Nat. Sci., Phila., 1859, 66. (Lake Superior); Jordan Bull. U. S. Nat. Mus. No. 10, 1877, 15. (Gr. Lake Region.)

Asproperca zebra Heckel.

Percina caprodes zebra Jordan, Ann. Rept. Com. Fish and Fisheries, 1884, 79.

Percina manitou Jordan, Proc. Acad. Nat. Sci., Phila., 1877, 53. (Lake Manitou in N. Indiana); Jordan, Bull. U. S. Nat. Mus. No. 10, 1877, 15. (Indiana to Minnesota); Jordan, Bull. 2 Ills. State Lab. Nat. Hist., 1878, 3. (L. Manitou, Ind., Wis.); Jordan, Bull. U. S. Geo. Surv., 1879, 438. (Indiana to Minne-

sota); Jordan, Geo. Surv. of Ohio, IV, 1878, 971. (Lakes of N. Ind., Mich. and Wis.)

Percina caprodes manitou Jordan & Gilbert, Syn. Fish. N. Am., 500, 1883. (Potomac R., Ills., Wis.); Jordan, Man. Vert., 1890, 126. (E. and N. U. S.)

To illustrate the distribution, the localities contained in the works quoted in the bibliography have been marked in the accompanying map.

The localities from which I examined specimens have been marked ♂. The areas inhabited by the various color patterns, as determined by my specimens, and by reports containing sufficiently minute descriptions, are indicated on the map by broken lines. The patterns distributed in each area is indicated by the number of the figure in the plates representing the pattern. In some cases it could not be determined which pattern occurred at the locality. There are some localities on the map, therefore, that are not included in any of the marked areas.

In conclusion, it may be observed:

1. The variation between specimens of the same locality is very slight.

2. The most complicated color pattern can be connected with the simplest by a series of intermediate stages.

3. The variation in color pattern cannot be connected with the latitude inhabited by the different varieties. The color variation is determined, but not in a direct line north and south.

4. The simplest color pattern of the body, found only in immature specimens, consists of nine transverse bars.

5. The simplest color pattern of adults consists of the nine bars seen in the young plus half bars between each two of the primary bars.

6. The next complication arises by the addition of quarter bars. These bars are first introduced in the region between the two dorsals, from which region variation seems to radiate.

7. Another complication may be the splitting of the bars into reticulations on the back and their intensification into larger spots along the sides.

8. Another modification is brought about by the shifting of the the lower half of the whole bars backward, which thus become separated from the dorsal halves. In this, the northernmost variety, the nape is naked.

9. In the simplest pattern, the two sides are usually symmetrical. If unsymmetrical, the asymmetry is introduced in the region of the spinous dorsal fin by a shifting forward or backward of the bars of one side in this region.

10. In the more complicated patterns the asymmetry has become the rule, and has spread along the region of both dorsals.

11. The variation in the combination of dorsal spines and rays is promiscuous.

12. The variation in the number of dorsal rays is promiscuous.

13. The variation in the number of dorsal spines is determinate. The southern specimens having a larger number of spines. Exception: the specimens from San Marcos Spring, Texas.

14. The variation in the number of anal rays is also determinate. As in the case of the dorsal spines, the number varies with the latitude, the southern specimens having a slightly larger number of rays.

EXPLANATION OF PLATES.

Fig. 1. *Etheostoma caprodes Rafinesque*, 33 mm., Chocola Cr. Oxford, Ala.

Fig. 2. *Etheostoma caprodes Rafinesque*, 83 mm., Bean Blossom, Ind.

Fig. 3. *Etheostoma caprodes Rafinesque*, 88 mm., Chocola Cr., Oxford, Ala.

Fig. 4. *Etheostoma caprodes Rafinesque*, 102 mm., Green R., Greensburg, Ky.

Fig. 5. *Etheostoma caprodes Rafinesque*, 115 mm., San Marcos, Spr., Tex.

Fig. 6. *Etheostoma caprodes Rafinesque,* 88 mm., Torch Lake, Mich.

Fig. 7. *Etheostoma caprodes Rafinesque,* 86 mm., Obeys R., Elizabethtown, Tenn.

Fig. 8. *Etheostoma caprodes Rafinesque,* 115 mm., Lit. S. Fork Cumberland R., Wayne Co., Ky.

Fig. 9. *Etheostoma caprodes Rafinesque,* 60 mm., Gosport, Ind.

Fig. 10. *Etheostoma caprodes Rafinesque,* 85 mm., Obeys R., Elizabethtown, Tenn.

Fig. 11. *Etheostoma rex* Jordan.

EXPLANATION OF MAP.

2. Pattern 2.
3. " 3.
4. " 4.
5. " 5.
6. " 6.
11. *Etheostoma rex* Jordan.

NEO-LAMARCKISM AND NEO-DARWINISM.[1]

By L. H. Bailey.

It is difficult to accept the hypothesis of organic evolution in the abstract. In the first place, there must be some reason for the operation of a law of transformation or development; and this is found in the ever-changing physical or external conditions of existence, which are more or less opposed to established organisms. And it may also be said that the very fact of the increase of organisms through multiplication must impose new conditions of competition upon every succeeding generation. Again, it is necessary to conceive of some means or machinery by which the process of evolution is carried forward. It was long known that all species vary, that is, that no two individuals in nature are exactly alike; yet there was lacking any hypothesis to show either why these varieties appear or how it is that some become permanent and some do not. The first scientific explanation of the process of evolution was that made in 1809 by the now famous Lamarck. He saw two factors which, he thought, were concerned in the transformation of species—the habitat and the habit. The habitat is the condition in which the organism lives, the environment. This environment, subject to change with every new individual, calls for new habits to adapt the organism to the new needs—inducing greater exercise of some powers or organs and less exercise of others. This greater or less use gradually strengthens or enfeebles the organ concerned, and the modifications thus acquired are preserved "through heredity to the new individuals that are produced by them, provided the changes are common to the two sexes, or to those that have produced these new individuals." There are three things to be considered in this hypothesis: 1. Changes in environment or the conditions of life react upon organisms in the direction of their needs or functions. 2. Organs or powers thus affected are modified to satisfy the new demands. 3. The modifications

---

[1] Extract from an address before the Philosophical Club of Cornell University.

acquired by the individual are hereditary. This, then, is Lamarckism—that the controlling factor or process in evolution is functional, and that acquired characters are readily transmissible. It is important that I still repeat Lamarck's belief in the transmission of a character obtained by any individual during its own lifetime, for this is the starting point of the definition of an "acquired character" concerning the hereditability of which the scientific world is now rent. "All that nature has caused individuals to acquire or lose through the influence of the circumstances to which their race has been for a long time exposed," says Lamarck, "it preserves," etc. And again, "Every change acquired in an organ by a habitual exercise sufficient to have brought it about, is preserved thereafter through heredity," etc. We shall presently observe how far this definition of an acquired character has been maintained by recent philosophers.

Just fifty years after the publication of Lamarck's theory, Darwin proposed a hypothesis which has had a greater influence upon the habit of scientific thought than any enunciation since the promulgation of inductive philosophy. Darwin, like Lamarck, saw that all forms of life vary; and like him, too, he perceived that there must be a fierce struggle for place or existence amongst the individuals of the rapidly succeeding generations. This variation and struggle are particularly apparent in cultivated plants; and Darwin saw that the gardener selects the best, and thereby "improves" the breed. "Can it, then, be thought improbable," says Darwin, "seeing that variations useful to man have undoubtedly occurred, that other variations useful in some way to each being in the great and complex battle of life, should occur in the course of many successive generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind?" "This preservation of favorable individual differences and variations, and the destruction of those which are injurious, I have called Natural Selection, or the Survival of the Fittest." This, then, is Darwinism—that the

controlling factor or process in evolution is selective: the survival, in the struggle for existence, of those individuals which are best fitted to survive. But while this is the naked core of Darwinism, there are various correlative or incidental hypotheses attached to it. Darwin, for instance, accepted in some degree the views of Lamarck as to the importance of functional characters; he considered that sexual selection, or the choice exercised in securing mates, is often an important factor in modifying species; he thought that variation is induced by the modifications of environment, or the "changed conditions of life;" and he was a firm believer in the hereditability of acquired characters. It is around these two great hypotheses—the functional or Lamarckian on the one hand, and the selective or Darwinian upon the other—in various forms and modifications, that the discussions of the philosophy of organic nature are at present revolving.

Before leaving the subject of Darwinism, I wish to touch upon Darwin's view of the cause of variation and his belief in the transmission of acquired characters. We shall presently see that the rehabilitation of the theories of Lamarck, under the name of Neo-Lamarckism, is undertaken, very largely, for the purpose of assigning the origin of variations to external causes, or to the environment, in opposition to those who consider the source of variation to be essentially innate or at least internal. But Darwin also believed that variation is induced by the environment, and the chief factor in this environment, so far as its reaction upon the organism is concerned, is probably excess of food supply, although climate, and other impinging circumstances, are potent causes of modification. He marshalled arguments to support "the view that variations of all kinds and degrees are directly or indirectly caused by the conditions of life to which each being, and more especially its ancestors, have been exposed," and that "each separate variation has its own proper exciting cause." I do not understand how it has come about that various writers declare that Darwin did not believe explicitly in the external cause of variation, and that they feel obliged to go back to Lamarck in order to find a hypothesis for the occasion. It is true that Darwin be-

lieved that the nature or direction or particular kind of variation in a given case, is determined very largely by the constitution of the organism, but variation itself, that is, variability, proceeds largely from external causes; and the characters arising in the lifetime of an individual may become hereditary. I must hasten to explain, however, that Darwin clearly recognized the importance of the union of sexes, or crossing, as a cause of variation.

While Darwin believed that the effects of variability arise "generally from changed conditions acting during successive generations," he nevertheless believed that the first increment of change—that arising in the first individual of a given series—might be directly carried over to the first offspring. That is, he believed in the hereditability of acquired or new external characters, a fact which is emphasized by his conviction that certain mutilations, and even the effects of use and disuse, may be transmitted. Yet, whilst Darwin accepted the doctrine, he believed it much less thoroughly than Lamarck did, and it is but an incidental part of his philosophy, while it is an essential tenet of Lamarckism.

Thus far, the heriditability of all important characters had not been disputed. In other words, heredity as a general law or force in the organic world, had been assumed. But with the refinement of the discussions it became necessary to conceive of some definite means through which the transmission of particular characters or features should operate; and it was soon found, also, that no philosophy of evolution can expect to explain the phenomena of organic life unless it is connected and co-ordinated with some hypothesis of the method of heredity. While, therefore, a hypothesis of heredity need not necessarily be associated with the abstract theory of evolution, all such hypotheses which are now before the scientific world have for their particular object the explanation of the assumed progressive tendency of the forms of life.

It is incomprehensible that the minute fertilized ovum or ovule should reconstruct the essential characters of the two individuals from which it proceeds, unless it has in some way derived distinct impressions from every part and organ of the

parental bodies which it reproduces. It would seem as if it must of itself be an epitome or condensation of its parents, with the power of unfolding its impressions or attributes during the whole life course of the organism to which it gives rise. Several hypotheses have been announced to account for the phenomena of heredity, of which, one of the most important is still Darwin's theory of pangenesis. Darwin supposed, provisionally, that besides the ordinary multiplication of the cell, each cell may "throw off minute granules which are dispersed throughout the whole system; that these, when supplied with proper nutriment, multiply by self-division, and are ultimately developed into units like those from which they were originally derived." These granules, or gemmules, have a natural affinity for each other, and they collect themselves "from all parts of the system" to form the sexual materials or elements. These sexual elements, therefore, which unite to form the new individual, are an epitomized compound of the parents. The value of this hypothesis, it seems to me, lies not so much in the particular constitution and behavior of these gemmules, as in the fact that it attempts to account for the known phenomena of life by supposing each corporeal element to be represented in the sexual elements. The hypothesis has never gained wide support, because of the supposed physical improbability of the gemmules and of their concentration in sexual system; yet it should be said that a simpler one, which can account for the facts, has not yet been advanced, unless it be the bathmic hypothesis of Cope, which supposes that each body-cell transmits "a mode of motion" to the germ-cell.

For the present purpose, we need consider but one other hypothesis of heredity—that advanced in 1883 by Weismann, which has given rise to the philosophy now called Neo-Darwinism. Weismann's point of view is interesting and unique. He places himself at the threshold of organic life and contemplates what takes place in the reproduction of one-celled organisms. These organisms multiply largely by simple division, or fission. When the organism reaches a certain size, it becomes constricted near its middle, and finally parts into two cells or organisms. It is evident that one organism is twin

of the other, neither is older, neither is parent, but each has partaken of the common stock of protoplasm. The protoplasm again multiplies itself in the two organisms, and at length it is again divided; and so, to the end of time, the remotest individual of the series may be said to contain a portion of the original protoplasm; in other words, the protoplasm is continuous. And inasmuch as protoplasm is the seat or physical basis of life, it may be said that the one-celled organism is immortal, or is not confronted by natural death.

In time, however, there came a division of labor—cells living together in colonies, and certain cells performing one function and certain other cells other functions. This was, perhaps, the beginning of the many-celled organism, in which certain cells developed the specific function of reproduction, or eventually became elements of sex. As organisms became more complex in their structure, there came to be great differences between this reproductive or germ portion and the surrounding or body portion; and Weismann assumes that these two elements are different and distinct from each other in kind, and that inasmuch as the one-celled organisms propagated their exact kind by simple division, that therefore the reproductive elements of the many-celled or complex body must continue to perpetuate their kind or enjoy immortality, while all the surrounding or body cells die and are reproduced only through the reconstructive power of the sexual elements. There are, then, according to this hypothesis, two elements or plasms in every organized being, the germ-plasm and the soma-plasm or body-plasm; and every organism which procreates thereby preserves its germ-plasm to future generations, while death destroys the remainder. A vital point in this hypothesis is the method by which the soma-plasm, or the organs and body of the organism, can be so impressed upon the germ that they shall become hereditary. At first it would seem as if some assumption like that of Darwin's might be useful here—that this germ-plasm is impressed by particles thrown off from all the surrounding or soma-cells; but this Weismann considers to be too unwieldy, and he ascribes the

transfer of these characters through the medium of the germ-plasm to "variations in its molecular constitution." In other words, there can be no heredity of a character which originates at the periphery of the individual, because there is no means of transferring its likeness to the germ. All modification of the offspring is predetermined in the germ-plasm; and if the new organism becomes modified through contact with external agencies, such modification is lost with the death of the individual. "Characters only acquired by the operation of external circumstances acting during the life of the individual, cannot be transmitted." "All the characters exhibited by the offspring are due to primary changes in the germ." It is admitted that the continued effect of impinging environment may, now and then, finally reach the germ-plasm, but not in the first generation in which such extraneous influence may be exercised. In other words, acquired characters cannot be hereditary.

It would seem as if this hypothesis precluded the possibility of evolution or the continued modification of species, inasmuch as it does not accept the modifications arising directly from external sources. But Weismann supposes that variation originates—or at least all variation which is of permanent use to the species—from a union of the sexes, inasmuch as the unlike germ-plasms of two individuals unite; and from the variations thus induced are derived the materials upon which natural selection works in the struggle for existence. "I am entirely convinced," Weismann writes, "that the higher development of the organic world was only rendered possible by the introduction of sexual reproduction." "Sexual reproduction has arisen by and for natural selection, as the only means by which the individual variations can be united and combined in every possible proportion."

It will be seen that Weismann is a Darwinian—a believer in natural selection as the one controlling process of evolution; but, unlike Darwin, he refers variation to sex and declares that any new or acquired character originating in the body of the organism cannot be transmitted. The exact means or machinery through which he supposes heredity to act, is rather

more an embryological matter than a philosophical one. We are particularly concerned in its results, which are the distinguishing marks of Neo-Darwinism—that variation is of sexual or internal origin, and that acquired characters are not hereditary.

In opposition to this body of belief, which has been upheld, particularly in England, with much aggressiveness, is Neo-Lamarckism, which is a compound of both Lamarckism and Darwinism, and which has an especially strong following in North America. The particular canons of this philosophy are the belief that external causes, or the environment, are directly responsible for much variation and that acquired characters are often hereditary. Other features of it, held in varying degrees by different persons, are the belief in the transforming effects of use and disuse, and in natural selection.

The one great schism between the Neo-Darwinians and the Neo-Lamarckians is the controversy over the hereditability of acquired characters, and just at present this question has come so strongly to the fore that other differences in the two hypotheses have been obscured. It is worthy of remark that Darwinism or Neo-Lamarckism sees first the facts or phenomena and then tries to explain them; while Neo-Darwinism or Weismannism assumes first a hypothesis and then tries to prove it. I think that any one will be struck with this difference of attitude, if he read Darwin's chapter upon pangenesis, and then read Weismann's essay upon heredity. The Neo-Darwinians are loud in demand of facts or proof that acquired characters are hereditary, and they attempt to throw the burden of proof upon their opponents; while, at the same time, they give no proofs of their own position, and confound their adversaries with verbal subtleties. The burden of proof, however, lies clearly upon the Neo-Darwinians, inasmuch as they have assumed to deny phenomena which were theretofore considered to be established.

A voluminous issue of polemics has occurred during the last five or six years between the Neo-Darwinians and the Neo-Lamarckians; but whatever may have been its effects upon the older philosophy, it is clear, to my mind, that some of the

attacks upon Neo-Darwinism are unanswerable in any rational manner, and it is certain that they have forced Weismann into a change of position with reference to some of his definitions. Certain phases of this discussion appeal with particular force, of course, to some minds, while they exert little influence upon others. My own objections to Neo-Darwinism—and I admit that my bias is strong against it—seem to be somewhat different from those most commonly urged in opposition to it; and the three which chiefly influence me I shall present very briefly.

1. I cannot see that the non-transmissibility of acquired characters is a necessary assumption to Weismann's fundamental arguments. I have already explained his reasoning from the reproduction of the one-celled organism. I cannot attempt any opinion of the probable facts upon which the hypothesis is founded. It may be said, in passing, that one of the prominent objections to the fundamental basis of the theory is the difficulty of deriving the mortal soma-plasm from the immortal germ-plasm, a question to which, however, Weismann has made a somewhat full reply.

When organisms became complex, it was necessary to assume either that the soma-plasm does or does not directly influence the germ-plasm. Weismann discarded the various hypotheses which suppose that there is a vital and necessary connection between the body units and reproductive units, and then to avoid the difficulties which the hereditability of acquired characters would entail, he supposed that such characters are not hereditary. His subsequent labors have been largely employed in trying to show that they are not. This supposition was made for the purpose of simplifying the hypothesis by removing the cumbrous gemmules of Darwin and the similar bodies or movements of other philosophers, and therefore by localizing the seat of the germ-plasm. But he immediately encounters difficulties quite as great as those which he avoids. In cases where there are alternate generations of asexual and sexual organisms, he must suppose that the germ-plasm is united with the soma-plasm, and is probably, therefore, distributed throughout the body. "There may be in fact cases," Weismann writes,

"in which such separation [of the germ-plasm from the soma-plasm] does not take place until after the animal is completely formed, and others, as I believe that I have shown, in which it first arises one or two generations later, viz., in the buds produced by the parent." And he has been compelled to admit that in the case of begonias, which are propagated by leaves, the germ-plasm is probably distributed throughout the foliage; and he must make a similar admission for all plants, for they can all be propagated and modified through asexual parts. This is admitting, then, that there is no localized germ-plasm in the vegetable kingdom and in some instances in the animal kingdom; and if the germ-plasm is distributed to the very periphery of the organism, why may it not be directly affected by environment, the same as the soma-plasm is? Or why is the hypothesis any the less objectionable than Darwin's pangenesis, which supposes that every organic unit can communicate with the germ?

Weismann also supposes, as I have said, that the means by which the germ-plasm is able to reconstruct the soma-plasm in the offspring, is through some modification in its "molecular constitution," an assumption which was by no means novel when Weismann announced it. "The exact manner in which we imagine the subsequent differentiation of the colony to be potentially present in the reproductive cell," he writes, "becomes a matter of comparatively small importance. It may consist in a different molecular arrangement, or in some change of chemical constitution, or it may be due to both these causes combined." In whatever manner the germ-plasm receives its somatic influences, there must be a direct connection between the two, and it is quite as easy to assume the existence of gemmules as any less tangible influence. I am not arguing in favor of pangenesis, but only stating what seems to me to be a valid objection to the fundamental constitution of the Weismannian hypothesis—that it is quite as easy to assume, from the argument, one interpretation of the process or means of heredity as another. And if there is any vital connection whatever between the soma-plasm and the germ-plasm—as the

hypothesis itself must admit—then why cannot the soma-plasm directly influence the germ-plasm?

Again, I wish to point out that modification and evolution of vegetable species may and does proceed wholly without the interposition of sex—that is, by propagations through cuttings or layers of various parts. This proves either one of two things—that the germ-plasm is not necessary to the species, or else that it is not localized but distributed throughout the entire body of the individual, as I have shown above; and either horn of this dilemma is fatal, it seems to me, to Weismannism. If the germ-plasm is not necessary to this reproduction, then we must discard the hypothesis of the continuity of the germ-plasm; if the germ-plasm is distributed throughout the plant, then we are obliged to admit that it is not localized in germ-cells beyond the reach of direct external influences.

This sexual propagation of plants has been brought to Weismann's attention by Strasburger, who cited the instance of the leaf-propagation of begonia, and said that plants thus asexually multiplied afterwards produce flowers and seeds, or develop germ-plasm. Weismann meets the objection by supposing that it is possible for "all somatic nuclei to contain a minute fraction of unchanged germ-plasm," but he considers the begonia, apparently, to be an exception to most other plants, inasmuch as he declares that "no one has ever grown a tree from the leaf of the lime or oak, or a flowering plant from the leaf of the tulip or convolvulus." Henslow meets this latter statement by saying that this has not been accomplished simply because "it has never been worth while to do it. If, however, a premium were offered for tulips or oak-trees raised from leaf-cuttings, plenty would soon be forthcoming." What Weismann wishes to show is that the begonia is an exception to other plants in allowing of propagation from leaf-cuttings, although he should have known that hundreds of plants can be multiplied in this way, and that—what amounts to the same thing—all plants can be propagated by asexual parts, as stems or roots.

But there is another aspect to this asexual multiplication of plants which I do not remember to have seen stated in this

connection. It has been said that the asexually multiplied plants may afterwards produce flowers and resume the normal method of reproduction and variation. I now wish to add- what I have already said, that plants may be continuously multiplied asexually and yet the offspring may vary, and the variations may be transmitted from generation to generation, quite as perfectly as if seed production intervened. This has been true with certain plants through a long period of time, as the banana, and every intelligent gardener knows that plants propagated by cuttings often "sport" or vary. Here are cases, then, in which variation does not originate from sex, unless Weismann is willing to concede that the result of previous sexual union has remained latent through any number of generations and has been carried to all parts of the plant by a generally diffused germ-plasm; and if this is admitted, then I must again insist that this germ-plasm must be just as amenable to external influences as the soma-plasm with which it is indissolubly associated. I have repeated this argument in order to introduce the subject of "bud variations," or those "sports" which now and then appear upon certain limbs or parts of plants and which are nearly always readily propagated by cuttings. These variations cannot be attributed to sex, in the ordinary and legitimate application of the Weismannian hypothesis. Whilst these "sports" are well known to horticulturists, they are generally considered to be rare, but nothing can be farther from the truth. As a matter of fact, every branch of a tree is different from every other branch, and when the difference is sufficient to attract attention, or to have commercial value, it is propagated and called a "sport." This leads me to recall the old discussion of the phytomer, or the hypothesis that every node and internode of a tree—and we might add the roots—is in reality a distinct individual, inasmuch as it possesses the power of leading an independent existence when severed from the plant, and of reproducing its kind. However this may be as a matter of of speculation, it is certainly true as regards the phenomenon, and shows conclusively that if the germ-plasm exists at all, it exists throughout the entire structure of the plant.

This conclusion is also unavoidable from another consideration—the fact that plants are asexual organisms at all times previous to flowering, and the germ-plasm must be preserved, in the meantime, along with the soma-plasm. But this conclusion is inconsistent with Weismannism as taught at present, and this alone would lead me to discard the hypothesis for plants, however well it may apply to the animal kingdom.

Henslow has made a different argument to show that the germ-plasm of plants may be directly exposed to external influence (*Origin of Floral Structures*). The germ-plasm is assumably located in the flower, and the egg-cell of the embryo-sac and the sperm-cell of the pollen grain are close to the surface, and are directly impressed by the interference of bees and other external stimuli. Henslow endeavors to show "that the infinite variety of adaptations to insects discoverable in flowers may have resulted through the direct action of the insects themselves, coupled with the responsive power of protoplasm." And these characters must be in part acquired during the lifetime of a given individual.

2. It seems to me, also, that the presumption, upon general philosophical grounds, is against the doctrine that immediate external influences are without permanent effect. If we admit—as all philosophers now do—that species are mutable, and that the forms of life have been shaped with reference to their adaptations to environment, then we are justified in assuming that every change in that environment must awaken some vital response in the species. If this response does not follow, then environment is without influence upon the organism; or if it follows and is then not transmitted, it is lost just the same, and environment is impotent. And it does not matter if we assume, with the Neo-Darwinians, that this effect does not become hereditary until the germ is affected—that is, until two or more generations have lived under the impinging environment—it must nevertheless follow that the change must have had a definite beginning in the lifetime of an individual; for it is impossible to conceive that a change has its origin in two generations. In other words, the beginning is singular; two generations is plural. And whether the modification is di-

rectly visible in the body of the organism or is an intangible force impressed upon the germ, it is nevertheless an environmental character, and was at first acquired. If this is not true—that the changed conditions of life exert a direct effect upon the phylogeny of the species—then no variation is possible save that which comes from the recompounding of the original or ancestral sex-elements; and it would still be a question how these sex-elements acquired their initial divergence.

The Neo-Darwinians would undoubtedly meet this argument by saying that their hypothesis fully admits the importance of these external influences, the only reservation being that they shall have affected the germ. It is true that this is a common means of escape; but it cannot be gainsaid that the denial of the influence of the external or environmental forces is really the fundamental difference between them and the Darwinians or Neo-Lamarckians, as the following quotation from Weismann will show: "Our object is to decide whether changes in the soma (the body, as opposed to the germ-cells) which have been produced by the direct action of external influences, including use and disuse, can be transmitted; whether they can influence the germ-cells in such a manner that the latter will cause the spontaneous appearance of corresponding changes in the next generation. This is the question which demands an answer; and, as has been shown above, such an answer would decide whether the Lamarckian principles of transformation must be retained or abandoned."

If, then, to repeat, organisms are adapted to their environment, it must be equally true that this environment directly affects its inhabitants; and considering the intense struggle for existence under which all organisms live, it is highly probable that any advantageous variation can be seized upon at once. I cannot conceive that nature allows herself to lose the result of any effort.

3. My third conviction against Neo-Darwinism arises from the fact that its advocates are constantly explaining away the arguments of their opponents by verbal mystifications and ingenious definitions. This charge is so frequently made, and

the fact is so well known, that it seems almost useless to refer to it here; and yet there are some phases of it upon which I cannot forbear to touch.

Weismann declares that he uses the term "acquired character" in its original sense. This term, or at least the idea, was first employed, as we have seen, by Lamarck, who used it or an equivalent phrase to designate "every change acquired in an organ by a habitual exercise sufficient to have brought it about." In fact, the basis of Lamarck's philosophy is the assumption of the hereditability of characters arising directly from use or disuse; and his idea of an acquired character is, therefore, one which appears in the lifetime of the individual from some externally inciting cause. Darwin's notion, while less clearly defined, was essentially the same, and he collected a mass of evidence to show that such characters are transmissible; and he even went farther than Lamarck, and attempted to show that mutilations may be hereditary. Weismann's early definition of acquired characters is plain enough. Such characters, that is, the somatogenic, "not only include the effects of mutilation, but the changes which follow from increased or diminished performance of function, and those which are directly due to nutrition and any of the other external influences which act upon the body." Standing fairly and squarely upon this definition, it is easy enough to disprove it —that is, to show that some characters thus acquired are hereditary. But the moment proofs are advanced, the definition is contracted, and the Neo-Darwinians declare that the given character was potentially present in the germ and was not primarily superinduced by the external conditions—a position which, while it allows of no proof, can neither be overthrown. A cow lost her left horn by suppuration, and two of her calves had rudimentary left horns; but Weismann immediately says, "The loss of a cow's horn may have arisen from a congenital malformation." Certainly! and it may not; and the presumption is that it did not. A soldier loses his left eye by inflammation, and two of his sons have defective left eyes. Now, "the soldier," says Weismann, "did not lose his left eye because it was injured, but because it was predisposed to become

diseased from the beginning, and readily became inflamed after a slight injury"! This gratuitous manner of explaining away the recorded instances of the supposed transmission of mutilations and the like, is common with the Neo-Darwinians, but it must always create the impression, it seems to me, of being labored and far-fetched; and inasmuch as it is incapable of proof, and is of no occasion beyond the mere point of upholding an assumed hypothesis, it is scarcely worthy serious attention. It would be far better for the Neo-Darwinians if they would flatly refuse to accept the statements concerning the transmission of mutilations, rather than to attempt any mere captious explanation of them; for it is yet very doubtful if the recorded instances of such transmissions will stand careful investigation.

But perhaps the most remarkable example of this species of Neo-Darwinian logic is produced by Weismann when he is hard pressed by Hoffmann, who supposed that he had proved the hereditability of certain acquired characters in poppies. Weismann says: "Since the characters of which Hoffmann speaks are hereditary, the term cannot be rightly applied to them;" thus showing that his fundamental conception of an acquired character is one which cannot be transmitted! He then proceeds to elaborate this definition as follows: "I have never doubted about the transmission of changes which depend upon an alteration in the germ-plasm of the reproductive cells, for I have always asserted that these changes, and these alone, must be transmitted." Then he proceeds to say that it is necessary to have "two terms which distinguish sharply between the two chief groups of characters—the primary characters which first appear in the body itself, and the secondary ones which owe their appearance to variations in the germ, however such variations may have arisen. We have hitherto been accustomed to call the former 'acquired characters,' but we might also call them 'somatogenic,' because they follow from the reaction of the soma under external influences; while all other characters might be contrasted as 'blastogenic,' because they include all those characters in the body which have arisen from changes in the germ. * * * We maintain that the

'somatogenic' characters cannot be transmitted, or rather, that those who assert that they can be transmitted, must furnish the requisite proofs." That is: changes in the soma-plasm are not transmitted; acquired characters are changes in the soma-plasm; therefore, acquired characters cannot be transmitted! Or, to use Weismann's shorter phrase, "Since the characters * * * are hereditary, the term ['acquired'] cannot be rightly applied to them!" Surely, Neo-Darwinism is impregnable!

Weismannism has unquestionably done much to elucidate some of the most intricate questions of biology, and it has weeded the old hypotheses of much that was ill-considered and false. It has challenged beliefs which have been too easily accepted. Its value to the science of heredity upon its biological side is admitted, and its explanation of the meaning of sex is one of the best of all contributions to the philosophy of organic nature. It has suffered, perhaps, from too ardent champions, and its great weakness lies in its stubborn refusal to accept an important class of phenomena associated with acquired characters, a sufficient explanation of which, it seems to me, could be assumed without great violence to the hypothesis.

Most Neo-Lamarckians accept much of Weismann's teachings. But, while there are comparatively few who believe that mutilations are directly transmissible, there is a general and strong conviction that many truly acquired characters are hereditary, and there seems to be demonstrable evidence of it; and while sex variation is fully accepted, it logically follows, if acquired characters are hereditary, that much variation is due directly to external causes. Perhaps the habit of thought of most Darwinians and Neo-Lamarckians is something as follows:

All forms of life are mutable. Variation affords the material from which progress is derived. Variation is due to sexual union, changed conditions of life, panmixia or the cessation of natural selection, and probably somewhat to direct use and disuse. There is an intense struggle for existence. All forms or variations useful to the species tend to live, and

the harmful ones tend to be destroyed through the operation of the simple agent of natural selection. These newly appearing forms tend to become permanent, sometimes immediately; but the longer the transforming environments are present, the greater is the probability, on the whole, that the resulting modifications will persist.

ORNITHOPHILOUS POLLINATION.

By Joseph L. Hancock.

The position that some of the humming-birds occupy in respect to the transference of pollen from flower to flower is by no means subordinate to insects.[1]

The common ruby-throated humming-bird (*Trochilus colubris*) though not endowed with specialized structures for the specific performanee of this office, bears upon careful study evidence that the mouth parts and feathers have certain means for the harboring of pollen quite beyond the ordinary views. The anatomical peculiarities of this bird's head allows access to flowers, covering a wide range of forms. A narrowing awl-shaped cone 29 mm. long represented by a base of 10 mm. admits of this latitude, as expressed more clearly in the accompanying plate, figures 2 and 3, of the head and skull. By reason of some flexibility, the bill is capable of probing to the bottom of nearly all the forms of flowers commonly met with. In the feeding process, familiar to almost every one, the flower is often bent over to be relieved of its juices. The trumpet honeysuckle (*Lonicera sempervirens*) in the proper season, furnishes an important part of the food of *T. colubris.* This vine appears wild in the south, the corolla of the flower is long, see figure 6, red and scentless. There is a way of accounting for this latter condition. Fragrant odors are largely essential to the attraction of bees and other insects, but as this plant does not lean upon their aid for fertilization, but depends more upon the humming-bird and larger moths for the interchange of pollen, the absence of fragrance is accounted for. The two last mentioned, from my own observations, depend for the most part upon sight for the detection of food plants. A male specimen of the ruby-throated humming-bird which was taken from a cat which had seized it in the act of feeding upon the nectar of flowers, was sent to the writer by a friend. From

---

[1] To this power in birds the designation of *ornithophilous* pollination is proposed in contradistinction to *entomophilous* pollination.

this and other dead specimens was derived much of the present knowledge. A cursory examination with the naked eye of the head does not reveal with clear distinctness the important facts brought out by the use of the microscope, consequently this instrument was brought into use in furthering research. Pollen is carried in several ways by this bird. On the lower mandible just in front of the angle of the mouth, overshadowed by the nasal scale when the bill is closed, a faint yellowish line marks the deposit of pollen grains resting in a small groove clustered together, see figure 5 at point b. Here were found various kinds, but one small form rather irregularly round in outline predominated. Pollen-grains work their way free to the summit or vanes of the feathers about where they were seen scattered, and as will be described further on, caught up by the barbs of the feathers, along the sides of the chin and lores ready to be deposited when a more suitable surface presents. Under the lower bill, see enlarged view, figure 4, and also 5a, the deep median groove, the point of meeting of the rami, which traverses along for nearly one-half its length, acts as a second repository. This pollen repository groove becomes divided backwards on either side for a short distance. Pollen lodges in larger quantities here and can be detected deep within the median portion of the groove. It is interesting to note that pollen found deep in the recess of this part bore evidence of greater age and possibly from foreign plants unknown to me. This fact opens up a line of investigation which promises interesting results in the future. With a needle the mass of grains which cluster together can be removed and separated with care. A small mass, only a fractional part of what still remained, showed with a focus of a ¼ inch objective hundreds of pollen-grains. The long shaft of the bill also had upon its surface a few scattered ones. The most noteworthy phase of this subject remains yet to be recorded when the feathers are analyzed in greater detail, for here is to be found the real means of scattering the pollen or pollination. The chief *repositories* having been just described as occurring below the angle of the mouth and in the median

groove under the lower mandible, it remains to mention the part taken by the feathers.

There are four ways by which the pollen becomes engaged or held by the feathers, which will be better understood after the anatomy of the latter structures are touched upon. The feathers from the sides of the head, lores and below, are mainly instrumental in this work. In general they are much like feathers of other birds, of the contour type, plumulaceous at the base, composed of a short, weak calamus, a rhachis, vanes, barbs and barbules; the latter being peculiar in that at the extremity of the vane the barbules are armed with sharp, thistle-like projections (barbicels) some of which are somewhat curved. The vanes at the base of the feathers are long and thread-like, near where they join the shaft are flattened oar fashion as seen in figure 8. Little pointed barbs divide these filimentous vanes at regular short distances. One of the methods of carrying pollen is here met with between two of the vanes as shown. The vanes of the upper part of the main body of the feather, are made up of narrow acute plates or barbs resting close together. The barbs of another vane often encroach or touch the barbs of a neighboring vane, so that between them is found entrapped many pollen-grains as demonstrated in figure 7. Another way by which pollen is effectually engaged is between two of the barbs merely spread apart, giving room for the grain to be held as in figure 9. The fourth method observed of carrying these fertilizing agents is an extraneous one, depending upon the glutinous secretion from the stigma of plants that adhere to the feathers, thus assisting the pollen to stick fast to the feather. Through a high magnifying power is seen the thistle-like ending of the vanes, the barbules frequently matted together by the sticky secretion referred to, gathered from the flowers while in search of food. Attached to the many pointed and flattened surfaces were seen pollen-grains of many kinds, chiefly of very minnte size, ready to depart or taken on anew at the next visit to a flower. In anemophilous flowers in which the wind is the agency for carrying the pollen, the grains are usually small, light, more or less dry and spherical, while in entomophilous

flowers, the pollen of which is carried from one plant to another by insects in search of honey, are variously adapted to cause the grains to adhere to the hairy underside of the insects body to promote their dispersion. In ornithophilous pollination the pollen is carried in such diverse ways that this together with other data combine to make it possible that the humming-bird is the most wonderful distributor of pollen known to the animal world. We are not content to leave the subject without noticing, that as compared with insects, the local range of flight of humming-birds is undoubtedly greater and during the regular migrations they make extensive flights.[2] Their summer home in eastern North America extends from the Gulf of Mexico to half way across the British Provinces and from the Atlantic Coast to beyond the Mississippi River. In winter its range is southward, reaching into Southern Florida, into Veragua and the western portion of the Isthmus of Panama, about eight degrees north of the equator. The equivalent of some 2000 statute miles is thus represented in the migrations of this diminutive bird. The pollen taken enroute during migration, as the humming-bird takes its sip of nectar from flower to flower, may gather in its repositories and be transported from place to place anywhere throughout its range. That some strange pollen grains are found entangled upon the bird is not surprising, especially in spring, taking these suggestions into consideration, and what wonder is it we are called upon to say that the phenomena of so widespread and perpetual a means of pollination of plants is perhaps unparalleled.

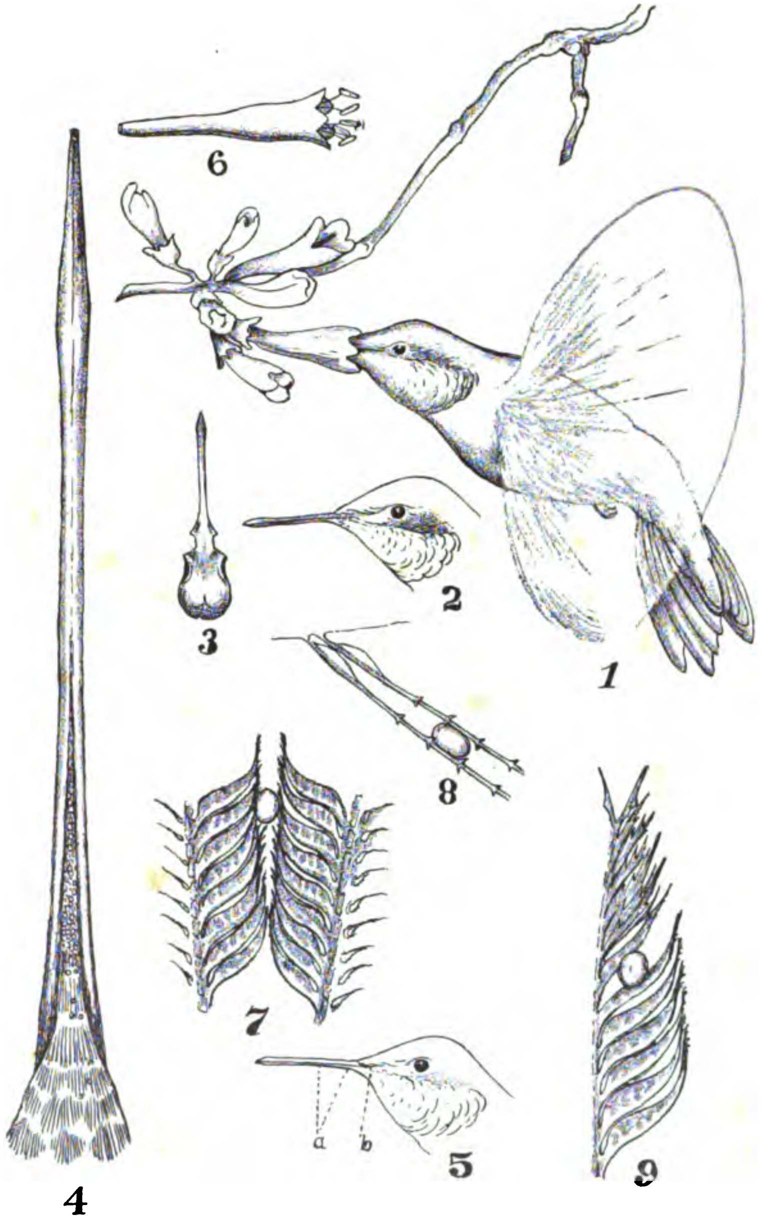
EXPLANATION OF PLATE.

Fig. 1. *Trochilus colubris* taking food, drawn from memory.
Fig. 2. Head of *T. colubris* from nature.
Fig. 3. Skin removed from head to show skull.

---

[2] It will be observed that the author refers entirely to the ruby-throated humming-bird (*T. colubris*) here, and what may be brought out by a further study of other species as regards to the part they play in pollination is a matter for the future.

PLATE XXII.



J L. Hancock. Del.

Ornithophilous pollination.

Fig. 4. Enlarged ventral view of lower mandible showing pollen repository groove.

Fig. 5. Head of *T. colubris* showing *a*, side repository, *b*, repository under the lower mandible.

Fig. 6. Single flower of Trumpet Honeysuckle.

Fig. 7. Two vanes side by side, *from main part* of a feather of *T. colubris*, showing one of the ways of carrying pollen-grains.

Fig. 8. Two vanes side by side of the same feather *from the base*, showing another way of carrying pollen-grains.

Fig. 9. One-half of a vane showing thistle-like structure at end of a feather, also showing another method of carrying the pollen-grains between two barbs. Pollen adheres to these feathers by aid of the sticky secretion of plants.

EDITORIALS.

—The U. S. Geological Survey has entered on a new era of its history, and one which will have an important bearing on the study of geology in this country. We look for a material improvement in the administration of this public trust, as compared with its history during the past ten years. Major Powell, who has just retired from the position of director, tried a good many experiments which were not judicious, and proposed to try others which were fortunately suppressed. It is to be greatly regretted that the Survey did not at the outset establish a modus vivendi with either the U. S. Engineers, or the Coast and Geodetic Survey, so that the topographic work could have been done by one or the other of these competent corps of men. They possessed the plant, both in men and in apparatus, but instead of arranging with one or the other of them, director Powell preferred to expend a large part of the resources of the Survey on this branch of the work. The topographic corps of the Survey constituted, perhaps, two-thirds of the entire force, and the expenditures for it were of course proportionately great. The new director, Dr. Walcott, inherits this incubus from his predecessor. The problem of its continuation as a part of the Survey's work is a serious one, in view of the reduced appropriations now granted by Congress. It may be considered in connection with the fact, that ultimately the geology of the United States will be represented on maps of first class topographic quality. It is frequently asserted that the maps hitherto produced by the Survey have not that high accuracy which the subject demands, although not without value for general purposes. The production of the best grade of map will probably require a greater outlay than has been heretofore granted for this purpose. Since the appropriations are less than heretofore, the assumption of this work by one or the other bureaus of the Government already mentioned would seem to be a necessity.

The importance of such a transfer is obvious from another point of view. The department of paleontology was inexcusably neglected by Major Powell, who had little appreciation of its importance to geology. So far as concerns vertebrate paleontology, the Survey's publications are distinguished by their absence, as based on collections in this department, for which large sums were expended. This failure of the Survey to render any equivalent for the expenditure, led Congress to restrict definitely the appropriation for this object, which was a misfortune for

which Major Powell is responsible, since the management of that department was of his own selection. The amount of work done in other departments of paleontology by the Survey is much less than it should have been. It is not necessary to call the attention of the present director of the Survey to the subject. An able paleontologist himself, he is not likely in his administration to neglect a department which is the life-blood of the science of geology. And, apart from its relations to geology, it has an especial importance of its own, which it is the business of a great government survey to foster.

In the later years of the Powellian period, the Survey made up for lost time in the quantity and quality of its stratigraphic work. It may be truthfully said that during the last five years no organization of the kind has turned out so large an amount of excellent original stratigraphic work at various and remote parts of the country. The habilitation of the Columbia, the Appomattox and Tuscaloosa formations of the Atlantic slope, and the correlation of the older paleozoic beds of the Appalachian Mountains must be credited to the geologists of the Survey. So also the definition of the epochs of the Cretaceous and Cenozoic beds of the coastal plain. The analysis of the strata of the Sierra Nevada has been immensely advanced, and much work has been done in the field of glacial geology. We look for a continuation of this work; and if some of the omissions of the past are supplied, the Survey will probably have the unanimous support of the scientific world.

—The publication of the geological map of Pennsylvania by the State Survey marks an era in the history of that organization. Professor Lesley, the director, has issued an atlas containing the map of the State in four sheets, together with detailed maps of Bucks and Montgomery Counties, with maps of the bituminous coal areas of the western counties, with others. An atlas of county maps is issued at the same time. The geological maps are well colored, and are a credit to the State. The amount of the appropriation did not permit of the insertion of the topography by contour lines in either the State or County maps. This is to be regretted, but may be left for some future survey, which may issue a new edition. An important and obscure problem has been greatly elucidated by Dr. B. S. Lyman, the author of the Montgomery-Bucks map, i. e., the analysis of the red beds which are generally referred to the Trias. His division of the formation into several horizons will aid research, and we await the evidence of their paleontology to determine the relations of some of them. Another

problem of even greater significance awaits the labors of the Survey. This is the discrimination of the Cambrian and Ordovician beds of the eastern border of the mountains. The Calciferous and Trenton limestones both exist in this series, but they are still included in one formation by the present survey, as they were by the first survey, as No. II. Walcott has already made some progress in this direction, and it is certain that many important results will be obtained by further research.

RECENT BOOKS AND PAMPHLETS.

Aarsberetning for 1892. Stavanger Museum, Stavanger, Norway. From the Trustees of the Museum.

Archivos do Museu Nacional do Rio de Janeiro, 1892. From the Museum.

Annals of British Geology, 1892. Introductory Review. From J. F. Blake.

Annuaire de l'Acad. Roy. des Sciences, des Lettres et des Beaux Arts de Belgique. Bruxelles, 1894.

Bulletin Iowa Agric. Coll. Exper. Station, No. 23, 1893.

Bulletin North Carolina Agric. Exp. Station, Nos. 55 and 93, 1893.

BLAKE, PROF.—On the Bases of the Classification of Ammonites. Extr. Natural Science, Vol. 3, 1893.

BOULE, M.—Découverte d'un squelette d'*Elephas meridionalis* dans les cendres basaltiques du volcan de Senèze (Haute Loire). Extr. Comptes rendus des séances de l'Acad. des Sciences, Paris, 1892. From the author.

BROOKS, W. K.—Salpa in its relation to the Evolution of Life. Studies from the Biol. Lab. Johns Hopkins Univ.. Vol. V, 1893.

——Salpa. A monograph with 57 plates. With a Supplementary Paper by M. M. Metcalf. Memoirs Biol. Lab. Johns Hopkins Univ., II, 1893. From the author.

COBB, N. A.—Nematodes, mostly Australian and Fijian. Extr. Macleay Mem. Vol., 1893. From the author.

CREDNER, H.—Zur Histologie der Faltenzähne Paläozoischer Stegocephalen. Des XX Bandes der Abhandl. der math.-phy. Classe der Königl. Sächs. Gessell. der Wissensch, No. IV, Leipzig, 1893. From the author.

DAMES, VON W.—Uber die Gliederung der Flötzformationen Helgolands. Sitzungsberichte der König. Preuss. Akad. der Wissensch. zu Berlin, 1893.

——Ueber Zeuglodonten aus Aegypten und die Beziehungen der Archæoceten zu den Uebrigen Cetaceen. Palaeontologlsche Abhandlungen, Neue Folge, Bd. I, Heft. 5. From the author.

DODGE, C. W.—Elementary Practical Biology. New York, 1894. Harper & Brothers, Pub. From the Pub.

DRAKE, N. F. AND THOMPSON, R. A.—Report on the Colorado Coal-field of Texas. Extr. Fourth Ann. Rept. Texas Geol. Surv., 1892. Austin, 1893. From the Survey.

GAUDRY, A. L'Eléphant de Durfort. Extr. du Vol. Com. du Centennaire de la fondation du Mus. d'Hist. Nat. de Paris, 1893. From the author.

GILL, T.—A Comparison of Antipodal Faunas.——Families and Subfamilies of Fishes. Extrs. Mem. Nat. Acad. Sci., Vol. VI. From the Acad.

GOEBEL, K.—Gedächtnisrede auf Karl von Nägeli gehalten in der öffentlichen Sitzung der k. b. Akad. der Wissensch. zu München am 21, März, 1893. Aus Denkschrift der k. b. Akad. München, 1893. From the author.

HAECKEL. E.—Der Monismus als Band zwischen Religion und Wissenschaft. Fünfte Auflage. Bonn, 1893. From the author.

JULIEN, A. A.—Notes of Research on the New York Obelisk. Extr. Bull. Am. Geog. Soc., 1893. From the author.

LAMPERT, DR.—Bemerkungen zur Süsswasserfauna Württembergs. Separat-Abdruck aus Jahreshefte des Vereins für vaterl. Naturk. in Württ., 1893. From the author.

LANGLEY, S. P.—The Internal Work of the Wind. Smith. Contrib. to Knowledge, 884. Washington, 1893. From the author.

LEBOUCQ, HERR.—Zur plastischen Anatomie der Fersengegend bei den Antiken. Abdruck aus Verhandl. der Anat. Gesell., Göttingen, 1893. From the author.

LYDEKKER, R.—Note on the Coracoidal Element in Adult Sloths, with remarks on its Homology. Extr. Proceeds. Zool. Soc., London, 1893. From the author.

Macleay Memorial Volume. Edited by J. J. Fletcher, Sept. 1893. From the Linn. Soc., New South Wales.

MARTEL, E. A. ET RAMOND, G.—Note sur la Cloche Gypseuse de Taverny. Extr. Feuille des Jeunes Naturalistes. No date given.

MERRIAM, C. H.—Preliminary Descriptions of four new Mammals from southern Mexico, collected by E. W. Nelson. Extr. Proceeds Biol. Soc., Washington Dec., 1893.

NEWTON, E. T.—On some new Reptiles from the Elgin Sandstone. Extr. Phil. Trans. Roy. Soc. London, Vol. 184, 1893. From the author.

PACKARD, A.—Further Studies on the Brain of *Limulus polyphemus*, with notes on its embryology. Extr. Mem. Nat. Acad. Sci., Vol. VI. From the Academy.

QUIROGA, DON FRANCISCO.—Sobre la existence de la humita en algunas caliza arcáicas de la Sierra de Guadarrama. Extr. Actas de la Soc. Esp. de Hist. Nat. t. II, 1893.——Estudio Petrográfico del Meteorite de Guareña, Badajoz. Extr. Anal. de la Soc. Esp. de Hist. Nat., t. XXII, 1893. From the anthor.

RAMOND, G —Geologie—Asie et Océanie. Extr. l'Ann. Géol. Universal, T. VIII, 1891. Paris, 1893. From the author.

RIDGWAY, R.—Remarks on the Avian genus Myiarchus, with special reference to *M. yucatanensis* Lawrence. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

RILEY, C. V.—Further Notes on Yucca Insects and Yucca Pollination. Extr. Proceeds. Biol. Soc., Washington, June, 1893.——Insects in Applied Entomology. Reprint Insect Life, Vol. VI, 1893. From the author.

SCUDDER, S. H.——The American Tertiary Aphididae. Extr. Thirteeth Ann. Rept. of the Director U. S. Geol. Surv. Washington, 1894. From the author.

SHUFELDT, R. W.—Notes on the Trunk Skeleton of a Hybrid Grouse. Extr. The Auk, Vol. X, 1893. From the author.

STILLMAN, J. D.—Natural System of Medecine. St. Louis, 1893. From the author.

SUESS, E.—The Future of Silver. Translated by Robert Stein. Washington, 1893. From the U. S. Geol. Survey.

TULLBERG, TYCHO.—Ueber einige Muriden aus Kamerun. Mitgetheilt aus der Konigl. Gesell. der Wissensch. zu Upsala, 1893. From the author.

WHITEAVES, J. F.—The Recent Discovery of large Unio-like Shells in the

Coal Measures at the South Joggins, N. S. Extr. Trans. Roy. Soc., Can., 1893. From the author.

WOODWARD, A. S.—Description of the Skull of *Pisodus owenii*, an Albula-like Fish of the Eocene Period. Extr. Ann. Mag. Nat. Hist., May, 1893.

——On the Cranial Osteology of the Mesozoic Ganoid Fishes, Lepidotus and Dapedius. Extr. Proceeds. London Zool. Soc., 1893.

——List of the Scientific Writings, 1882–1892. Hertford, 1893. From the writer.

ZITTEL, K. A.—Handbuch der Paleontologie; I Abtheilung. Paleozoologie Vertebrata; IV Band; 3 Lieferung; München und Leipzig, 1893. From the author.

RECENT LITERATURE.

The genus Salpa.[1]—The Johns Hopkins Press has issued the second of the series of "Morphological Monographs," in the shape of a magnificent treatise on the genus Salpa by Professor W. K. Brooks. The monograph is an exhaustive one, without which no working library can afford to remain. It includes a brief but valuable survey of the anatomy of many species, a detailed account of the development of the solitary form from the egg, and of the chain Salpa from the stolon. The systematic position of Salpa with reference to other tunicates is discussed, and this leads the author to a wide biological consideration of the primitive pelagic fauna and the origin of the Metazoa. The evidence on the origin of the Chordata, to be gathered from the tunicates, is presented and is shown to be in opposition to the annelidian hypothesis of the derivation of this group. Dr. M. M. Metcalf contributes the final section, a careful study of the eyes and subreural gland of Salpa.

The chapter on the egg development of the solitary Salpa is especially interesting and suggestive. An outline of this remarkable development is as follows: The germ mass is present in the embryo of the solitary form, and extends into the stolon as the latter grows out. It is differentiated into a superficial epithelium and an inner mass of ovarian ova, which in the mature stolon form a single row. When the stolon is constricted to form the chain of salps, each Salpa body gets its particular portion of the elongated germ mass. In most species this consists of a single egg with its surrounding epithelium. The latter is differentiated into testes, follicle, and fertilizing duct, i. e. a tube attaching the egg to the dorsal wall of the chain salp, through which the spermatozoa pass to reach the egg—the egg itself lies in a blood sinus of the chain salp. It is evident from these facts that the alternation of generations in Salpa differs from the typical alternation of generations, in that the solitary form does not arise from the chain Salpa, but from an egg passed into the chain Salpa from the preceding generation of the solitary form.

As the embryo grows, it pushes out of the blood sinus in which it lies at first, into the cavity of the cloaca, driving the wall of the cloaca before it. From the dorsal wall a complicated system of covering

---

[1] The genus Salpa, by William K. Brooks. Baltimore, The Johns Hopkins Press, 1893.

embryonic membranes is formed. The inner end of the embryo remains exposed to the blood sinus of the chain salp, and from it the placenta is formed. The placenta of Salpa is fundamentally different from that of the Mammalia. It is merely a portion of the embryonic body through which the blood of the chain salp circulates. It appears to be exclusively a nutritive organ, not respiratory. The stream of water constantly passing through the cloaca of the chain salp and bathing the body of the embryo, makes a special respiratory organ unnecessary. The placenta performs its nutritive function in a way very different from that of the corresponding mammalian organ. In Salpa the placental blood current nourishes the placenta itself and causes the cells to multiply. The latter migrate into the body cavity of the embryo, where they degenerate and are used as food.

The very remarkable character of the egg development is due to the peculiar behavior of the follicle. During the segmentation of the egg, the follicle undergoes a considerable increase in size. Its cells proliferate and the follicle assumes a shape, which may be likened to that of a mature Graafian follicle of the vertebrate ovary. That is, there is a superficial (or somatic) layer of the follicle, connected over a small area with a central mass (visceral layer), the two elsewhere separated by a cavity. The blastomeres, which are forced apart by the growth of the follicular tissue, lie in the visceral layer and the region where visceral and somatic layers are connected. The follicle now proceeds to develop, as if it were going to form the embryo, while the blastomeres remain few in number, scattered about in the midst of the mass of follicular tissue. It is impossible without figures to explain the way in which the follicular tissue is folded and hollowed out, to form the various parts of what appears to be the embryo. It may be said in a word that the follicular tissue gives rise to a body, which is a "simulacrum of the embryo." In this body, pharynx, cloaca, gill and gill-slits, are all developed, but are lined with the follicular cells of which the great mass of the body is composed. As the various organs are outlined in the follicular tissue, the blastomeres take up certain more or less definite positions with reference to each organ. Finally the blastomeres begin a rapid growth, and in each organ and throughout the body they take the place of the follicle cells, the latter degenerating and being ultimately used up as food. Thus in fact the Salpa embryo, like that of other animals, is derived from the egg cell and not from the follicle, as some investigators have held.

Professor Brooks suggests an explanation, which is probably the true one, of the behavior of the follicle in the Salpa embryo. It is well known that in many tunicates the follicle cells migrate in between

the blastomeres, more or less completely surrounding the latter, in which position they are finally used up as food. And the peculiar behavior of the follicle in Salpa is probably to be explained on the theory that Salpa has had an ancestor in which the follicular tissue persisted late in the development, and was so accurately disposed around and between the organs as to form what might be called a cast of the embryo.

In the modern Salpa, as in the hypothetical ancestor, the follicular tissue develops into a cast of the embryo, but the blastomeres instead of leading the way as they doubtless did in the ancestral embryology, are now so retarded in their development that they do not begin to build up the embryonic organs until the follicular cast is well nigh completed. H. V. Wilson.

Bateson's Dictionary of Variaton.[1]—In this work the author has collected a great many examples of variations from normal structures found in animals. These include both absolute abnormalities and variations which are in the line of evolution. The work is a useful one to all zoologists aud students of evolution, as furnishing examples of variation in groups with which they are not personally familiar. It will, however, not take the place with any specialist of his knowledge of the subject matter of his own studies. It is not to be supposed that its author intended that it should. A dictionary of variation of all animals would be a detailed work on zoology in general, where the normal characters of all species should be stated, in order that it might be shown what constitutes variation. Such a work could only be produced by the cooperation of a large number of "species naturalists." Embryologists and histologists would be wholly unfit for the task. Perhaps it was a sense of this deficiency which led Mr. Bateson to prepare this work; for otherwise it is difficult to imagine why an expert in any branch of zoological sciences should attempt the task, unless it should be designed for amateurs and general readers. While preparing the work, its author neglected one of the richest mines of information as to normal variation. This is found in the writings of American specialists in vertebrate zoology, where the subject has been treated in greater detail, and with greater wealth of material than exists in the literature of any other country. The book is well illustrated, which greatly enhances its value. We recommend it for study to persons who are doubtful in their opinions on the subject of organic evolution.

[1] Materials for the Study of Variation treated with especial Regard to Discontinuity in the Origin of Species. MacMillan & Co., London, 1894, pp. 598.

General Notes.

GEOGRAPHY AND TRAVELS.

Antarctic Exploration.—The most important geographical discoveries made in the Antarctic regions since Ross traced a part of Victoria Land's coast, and saw its smoking mountains, fifty-two years ago, have just been reported by an old and well-known Norwegian whaler, Captain Larsen, who, by this time, is undoubtedly on his way home with a cargo of seals. His discoveries were made in the latter part of November and early in December last, on the steam whaler Jason. Later he went north to the Falkland Islands, where he found an opportunity to send home his log for this period. He then returned to the sealing grounds near the Antarctic Circle. His log was forwarded from Norway by Mr. Christensen of Sandefjord to Dr. John Murray, the well-known Scottish scientist and member of the Challenger expedition, who has just published the extract from the Jason's journal in the *Scottish Geographical Magazine.* Only a few lines, including the latitude and longitude attained, are given in the log to each day's events, and the narrative is therefore lacking in detail. When Capt. Larsen returns to Europe, he will doubtless give a full account of his interesting voyage.

If the reader will refer to a map of the Antarctic regions, he will see a large land mass, known as Graham's Land, lying across the Antarctic Circle, south of Cape Horn. Except Victoria Land, which lies on the other side of the Antarctic area, Graham's land is the largest bit of *terra firma* that has yet been found in South Polar waters. It was discovered by John Biscoe in 1831, and a brief allusion to the exploration there is necessary in order to understand what Larsen has achieved. Biscoe skirted its lofty western coast for about 200 miles, and, landing on little Adelaide Island, not far from the mainland, he was the first to set foot on shore within the Antarctic Circle. No one ever saw any other part of Graham's Land except Ross, over fifty years ago, and the Scottish and Norwegian whalers who were there in the season of 1892-93. Capt. Larsen's recent achievement was to steam for days along the east coast of the unknown land, and when he was finally compelled to turn north again, he could still see the lofty summit of the mainland stretching south and east as far as the eye could reach. Dr. John Murray

and other authorities believe that in those days he was skirting a part of the coast of the great Antarctic continent, and while he was adding to our knowledge of the coast lines around the South Pole, he also discovered some volcanoes in a highly active state, showing that Plutonic energy in that part of the world has not yet died out, and that its activity there is more widely distributed than we had any reason to suppose.

The ice conditions greatly favored Capt. Larsen, for he found a comparatively open sea, and was able to advance about one hundred miles south of the Antarctic Circle. Only the year before the whalers had found the sea packed with ice almost to the extreme northern part of Graham's Land. As they looked south they saw a chain of bergs towering high above their ships, which effectually barred their progress in that direction. After Ross, in his sailing ships Erebus and Terror, had discovered Victoria Land and skirted its coast for hundreds of miles, he spent almost the entire season of 1842-43 near the north end of Graham's Land trying in vain to push his way through the ice-encumbered sea and the great chain of bergs. He was not able, however, to advance toward the south until he went far east, out of sight of Graham's Land, whose mystery he had hoped to solve. Larsen had a very different experience in November and December last. The weather was fine and warm, and there was plenty of sunshine and little fog. The air and sea teemed with animal life, for many birds, whales and seals were seen, and, best of all, the white, east coast of Graham's Land, rising here and there into lofty peaks, stood out clearly in view. He followed it straight to the south, until, at its furthest point, he saw it rising to still loftier heights and stretching away to the southeast and east.

From Capt. Larsen's log, and from the observations of the whalers at the north end of Graham's Land, in the previous season, we are able to get some idea of this *terra incognita*. According to his log, Capt. Larsen steamed along this east coast for 230 miles, the coast line stretching away a little east of south, a high, rocky shore, most of it a few miles west of 60° west longitude from Greenwich. Right at the Antarctic Circle is a very high peak, most of which is bare of snow. The shore front is skirted with an ice barrier that runs about five miles out to sea, and is from twenty-five to sixty feet high. The land is covered with an ice cap and glaciers flow down the valleys, but in the narrow, northern part of the land they are, of course, small, and do not produce icebergs over sixty to seventy feet in height. In 1892-93 the whalers saw in the neighboring waters bergs that were 200 feet or more

in height, and their depth below the surface must have been at least 1,400 feet. It is certain that they come from some more southern part of the Antarctic region.

Skirting the shores, Larsen saw numbers of islands and rocks, all volcanic and mostly basaltic, rising out of the sea almost as perpendicular as the icebergs, and presenting little surface on which snow can rest. He succeeded, however, in landing on Seymour Island, and pushed some distance into it, though the walk was most difficult across the deep valleys and over the high rocks. Great numbers of penguins had their nests there, and in the interior he found several dead seals. These penguins are peculiar to the Antarctic regions, and their rookeries are very curious. They are occupied by countless numbers of the common black-throated penguins, and the nests are crowded together in square blocks formed by paths intersecting one another almost at right angles. The whalers of the previous year said that these rookeries, viewed through a telescope from the ship's head, had the appearance of hair brushes, the penguins representing the bristles.

It was about eighty miles north of the Antarctic Circle that Larsen discovered a chain of five little islands, extending in a straight line from northwest to southeast. The most northern is about ten miles from the mainland. Two of these islands are active volcanoes. The captain and his mate fastened on their snow-shoes and crossed on the ice to one of the islands. A large volume of smoke poured from both of the volcanoes, but neither of them was ejecting lava or solid matter at the time, though the ice in the neighborhood was strewn with volcanic stones that had recently been hurled out of the craters. There was no snow on these volcanic masses.

On his journey south, Capt. Larsen saw many whales and seals. It is well-known that the Dundee whalers turned their attention to the Antarctic regions in 1892, in the hope of finding the true whalebone whale, which Sir James Ross believed he saw there. The Dundee fleet, however, saw neither this variety nor any sperm whale. They saw any number of finners, which were so tame that the ships actually struck them sometimes before they would get out of the way. Now and then these enormous creatures, not less then eighty feet in length, jump like a salmon, every portion of their bodies being clear of the water. The hunchback whale, which was found there in great numbers, is another interesting species. The whalers say that neither salmon nor trout fishing can equal the hunchback for sport. Larsen hunted one which, on being harpooned, ran the five lines in the first boat straight out and got free. Four additional harpoons and six rockets

were fired into it. It fought a thirteen hours' battle and then escaped, taking with it a good deal of line, two of the harpoons, and all of the rockets. Larsen saw three other species of whales there, but none of much commercial value, while the seals are desirable chiefly for their oil.

The most southern point reached by Capt. Larsen was in 68° 10 south latitude. Had he advanced a few miles further, it would have been necessary to turn quite abruptly to the east, for he saw the shore line bend around till it ran almost due east and west, and behind it was high land covered with snow. He had followed the coast on the east side of Graham's Land as far as Biscoe had traced it on the west. On the map the reader will find Alexander I. Land, which is due west of the high land seen by Larsen when he turned his ship to go north again. Dr. Murray believes that Alexander I. Land is a part of the west coast of Graham's Land, and that this landmass, which Biscoe and Larsen proved to widen rapidly toward the south, is only a peninsula of the continent of Antarctica.

It is interesting to consider the geographical significance of Larsen's voyage. Our maps show that all around the Antarctic area, in the neighborhood of the South Polar circle, bits of land have been discovered. It is noteworthy that scarcely one of these bits of land has been explored in its whole extent. The explorers did not ascertain whether the land they saw was islands or projections from some great landmass. Discoverers have very rarely been able to effect a landing on account of the belt of pack ice or ice floes, often ten to twenty miles wide, that separated them from the shore. There are several excellent reasons why many of the leading geographers and geologists believe that these various lands—Victoria, Graham, Wilkes, Adelie, Clarie, Sabrina and Termination Lands and some others, are merely parts of the outer edge of a large continent. To mention here only one of these evidences, the Challenger expedition, sounding in Antarctic waters, brought to light material which is regarded as strongly indicating the proximity of a landmass of continental proportions. Ross believed this when he was in the region where Larsen has made his reconnoissance. Ross said that though the ice prevented him from taking his vessel south, he believed he could have landed and travelled over the continent. Larsen's work adds strength to the theory, for we see Graham's Land rapidly widening as its coasts are followed toward Victoria Land. A great deal of the area within the Antarctic Circle may be covered with the sea and still leave room there for a land of continental extent. It has been observed, when possible to approach the land, that there is much

similarity in the geological structure of the apparently detached masses. Dr. Wild, of the Challenger expedition, has observed that Graham's Land and Victoria Land are remarkable for the height of their mountain ranges, rising from the sea to 7,000 feet in the former, and 15,000 feet in the latter country, and the shores of both are guarded by numerous islands, mostly of volcanic origin. Wild, Murray, and others say that we are justified in concluding that Victoria Land, whose east coast line was traced by Sir James Ross for more than 500 miles, must extend much further to the west and south, and that probably on its ice cap will be found the present position of the South Magnetic Pole.

Dr. Murray points out that the summer excursion of Larsen's little whaler, shows what large additions might, in a short time, be made in our geographical knowledge by a properly equipped expedition provided with steam power. British geographers will be more than ever encouraged, now that the news of Larsen's work has come to them, to redouble their present efforts to induce their Government to send out an expedition. The expenditure will hardly be justified unless the proposed expedition is accompanied by scientific men and fitted with all the apparatus of scientific investigation. Such a party and equipment would enrich almost every department of natural science. There is no doubt that the science of our day is demanding such an investigation, and, in all probability, it will be carried out within the next few years. Not only scientific men, but also a considerable part of the public, would like to know the nature and extent of this Antarctic continent and what may be learned by pushing into its interior. It is highly desirable, also, as the advocates of South Polar exploration have shown, to ascertain the depth and condition of the ice cap, to sound the ocean depths, to learn its various temperatures, from the surface to the bottom, to trawl up the animals on the sea floor, and study the nature of the marine deposits. These are among the questions that explorers will be called upon to solve in the prolific field of South Polar research.—Cyrus C. Adams, in *New York Sun.*

MINERALOGY.[1]

Friedel's Cours de Mineralogie.[2]—The first part of a text-book of mineralogy by Charles Friedel covers the field of general mineralogy. In the preface it is stated that a second part, devoted to special or descriptive mineralogy, will be prepared with the assistance of M. George Friedel, the author's son. The book does not claim to be, the author states, a treatise on crystallography or crystal physics, but a practical method of determining minerals on the basis of their morphological, physical, and chemical properties. It is intended for the use of those 'students who are preparing for the examinations for licentiate in physical sciences, and should therefore be adapted to the needs of college students.

The book contains 416 pages with the subject matter distributed as follows: introduction (giving history of science and fundamental definitions, 16 pages); organoleptic properties, 16 pages; crystallography, 238 pages; physical (and optical) properties, 59 pages; chemical composition occupies the remainder of the book and includes the divisions, blowpipe methods, mineral synthesis, and mineral classification. Under organoleptic properties are included among others, structure, color, lustre, density, external form (with a consideration of pseudomorphs), hardness, and streak. In treating crystallography eight pages are devoted to an exposition of Hauy's *théorie des décroissements.* This is followed by sections on the law of rational indices and symmetry. After deriving the crystal systems, the author gives eight pages to an exposition of Bravais's theory of crystal structure. No mention is made of the work of later writers on this subject, and throughout the book a tendency to utilize mainly the work of French writers seems manifest. The difficulties of translating Levy's symbols into those of Weiss, Naumann, Dana and Miller, makes it necessary to devote thirty-seven pages to crystallographic notation. Twelve of these are consumed by a table giving the equivalents of Levy's symbols in the other notations. An usually large amount of space for a book of this sort is devoted to the representation of crytals, but those which illustrate the book are very poor. Many of the figures are not merely carelessly, but incorrectly drawn. Crystals having a principal

---

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Cours de minéralogie professé a la faculté des sciences de Paris, par Charles Friedel. Minéralogie générale, pp. iii and 416. Paris, 1893.

axis are generally lopsided. Figures 70, 138, 224, 255 and 322 are a few of the incorrectly drawn crystals. Another bad feature of the illustrations is that crystals are not always properly set up but are seen from all directions. The best portions of the work are those which treat optical mineralogy and mineral synthesis. The former is treated without mathematics and in a simple and practical manner. The section on the classification of minerals is very unsatisfactory. What purports to be a history of the subject is given. The systems mentioned are those of Werner, Hauy, Beudant, Delafosse and Dana. Groth's system is not mentioned nor is that of any other modern German mineralogist. A considerable number of pages is devoted to detailed lists of minerals as they appear in the schemes of Werner, Delafosse, and Dana. With the exception of the latter, which Friedel adopts as the one most in harmony with the present state of the science, these lists seem out of place. The book is not provided with an index, but has a somewhat extended table of contents.

As a text-book the work is subject to criticism on account of its classification and arrangement of subject matter, its lack of perspective in the treatment of the different divisions of the subject, its tendency to utilize mainly French investigations and systems, and its faulty illustrations.

Relation between Atomic Weight and Crystal Angles.— In a paper entitled, "Connection between the Atomic Weight of contained metals and the magnitude of the angles of crytals of isomorphous series, a study of the potassium, rubidium and cæsium salts of the monoclinic series of double sulphates $R_2M(SO_4)_2$ 6 H_2O," Tutton[1] has given the results of a most careful and thorough crystallographical study of an isomorphous series of salts, to determine the kind and degree of effect which the different bases exert upon the crystal angles. The results are very interesting since they seem to show a relation between the atomic weights of the contained bases and the crystal angles. The work involved no less than 9,500 measurements. The crystals were obtained by slow crystallization from cold solutions and ten good crystals of each salt were selected for measurement from a dozen or more different crops. The double salts of the formula $R_2M(SO_4)_2$ 6 H_2O containing as univalent metals either potassium, rubidium, or cæsium, and as bivalent metals either magnesium, zinc, iron, manganese, nickel, cobalt, copper, or cadmium, were always pre-

---

[1] Jour. Chem. Soc. London, Trans., Vol. LXIII, (1893), pp. 337–423.

pared by mixing solutions of the two simple sulphates in equal molecular proportions. The study shows that the bivalent metal exerts no appreciable effect on the crystals, the predominant effect being due to the univalent metal present. The crystals of the potassium, rubidium, and cæsium salts have each a peculiar habit, that of the rubidium being intermediate between the other two. The axial angle β increases from the cæsium, through the rubidium to the potassium salt, its value in the rubidium salt being midway between the values in the cæsium and potassium salts. This is in close correspondence with the differences between the atomic weights of those bases. Tutton says "The relative amounts of change brought about in the magnitude of the axial angle by replacing the alkali metal potassium by rubidium and the rubidium subsequently by cæsium, are approximately in direct simple proportion to the relative differences between the atomic weights of the metals interchanged." The other crystal angles of the rubidium salts are likewise intermediate in value between those of the potassium and cæsium salts, but they do not show the same relation to the atomic weights of the alkali bases, the maximum deviation from such a relation being found in the prism zone. As these angles are for rubidium nearer to those of potassium than to those of cæsium, the author thinks that as the atomic weight of the alkali metal introduced gets higher, the effect of the metal on certain angles increases beyond a mere numerical proportion. Professor Tutton announces that this communication will be followed by another, which will discuss the changes in the optical constants of the crystals due to the same chemical substitutions.

Spangolite from Cornwall.—Miers[4] has found in a collection of Cornwall minerals presented to the British Museum, small crystals of the new mineral spangolite described by Penfield in 1890. The Cornwall crystals show the hexagonal prism, pyramid, and base. Their association is remarkably like that of Penfield's spangolite, as they occur with cuprite and its alteration products. From the characters of the associated liroconite and clinoclase, Miers thinks that there can be no doubt that the specimen is from St. Day, near Redruth.

Eudialite from the Kola Peninsula.—The occurrence of eudialite in the nephelene syenite and pegmatite of the Lujawr-Urt and Umptek in Russian Lapland, recently mentioned by Ramsay, has now been studied in detail.[5] The crystals have developed on them the

---

[4] Neues Jahrbuch, 1893, II, 174.

[5] Neues Jahrbuch, Beil. Bd., VIII, (1893) 722.

forms R,—½R, ¼R,—2R, ∞ R2, ∞R, and oR. The axial ratio is a:c =1:2.1072. The mineral has good cleavage parallel to the base and one varying from very good to poor runs parallel to the second order prism. The color is usually cherry to garnet red. The crystals are specially interesting because of a marked zonal structure and of a division into sectors having differences in double refraction. Some of these sectors have positive and others negative double refraction. Like the eudialite from Magnet Cove the crystals are optically anomalous, sometimes having biaxial character with optical angle as large as 15°. On heating the sections of the crystals to a temperature at which boracite had become isotropic, all the sectors of the field seemed to give negative double refraction. Ramsay finds evidence that the different zones of the mineral possess different specific gravities as well as different double refraction, and he considers this to be due to isomorphous growth together of eudialite and eucolite. He shows that as regards axial ratio, specific gravity, double refraction and optical character, there is a gradation from the eucolite of Arö through the eudialites of Umptek and Kangerdluarsuk to the eudialite of Magnet Cove.

PETROGRAPY.[1]

The Ejected Blocks of Monte Somma.—Johnston Lavis[2] has begun a thorough study of the ejected blocks of Monte Somma, with especial reference to their petrography and the nature of the metamorphic changes that have been produced in them by the lavas by which they were enclosed. The druse minerals of the blocks have long been known, but their nature as rocks has been left uninvestigated. The author proposes to study in detail about 700 specimens of the blocks, including many varieties. He begins by describing some 30 that were originally stratified Cretaceous limestones containing carbonaceous material. The first stage in their alteration seems to be the conversion of bituminous substance into graphite, and the crystallization of the rock into marble. The crystallization has not destroyed the original bedding bands, nor the most delicate structures exhibited by them, hence it is assumed that fusion or softening of the rock did not accompany the crystallization processes. A few olivines were formed at this tisme, and these consequently are the first products of the metamorphosing agency. They appear principally as inclusions in the calcite. In the next stage of alteration the graphite disappears, and a saccharoidal marble results. This contains more or less colorless olivine, and passes rapidly into a mass of olivine, colorless pyroxene, wollastonite and biotite, where impurities were present in the original rock. In the earlier stages of metamorphism the calcite and the silicate minerals will exist in different bands, but in later stages silicates and calcite intermingle, and finally a purely silicate rock results. The order in which new minerals seem to develope is thought to be the following; olivine, periclase, humite, spinel, mica, fluorite, galena, pyrite, wollastonite, garnet, vesuvianite, nepheline, sodalite, feldspar, secondary calcite, tremolite, brucite. The article is illustrated by three lithographic plates. It will repay close study by students of contact action, as we have recorded in the blocks the effects of the action of a magma upon a limestone, in all its stages.

Phonolites from the Black Hills.—The sanidine-trachyte described by Caswell[3] from Bear Lodge in the Black Hills, has been

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville. Me.

[2] Tarns. Edin. Geol. Soc., VI, 1893, p. 314.

[3] U. S. Geog. & Geol. Survey of Rocky Mts. 1880. Cap. VII, p. 471.

reexamined by Pirsson,[4] who finds it to be a phonolite with phenocrysts of anorthoclase and pyroxene, in a groundmass of the usual components of phonolite. The anorthoclase has the composition:

SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O	K_2O	H_2O	Total	Sp. Gr.
66.44	19.12	.56	tr	7.91	5.10	.57	= 99.70	2.585

The nepheline is all in the groundmass where it appears as idiomorphic crystals. The density of the rock is 2.582 and its composition:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	BaO	MgO	Na_2O	K_2O	H_2O	Cl	SO_3	Total	Cl
61.08	.18	18.71	1.91	.63	tr	1.58	.05	.08	8.68	4.63	2.21	.12	tr	= 99.86	—.03 = 99.83

A second occurrence of phonolite within the same region is in a dyke just south of Deadwood. It consists of phenocrysts of reddish feldspars and black hornblendes that approach barkevikite in properties. The rock from the Black Hills sold by the dealers as tinguaite is a dense aggregate of pyroxene phenocrysts in a matrix of feldspar and aegirine, with an occasional patch of nepheline.

The Origin of Norwegian Iron Ores.—The iron and other ores of many of the Norwegian localities are connected genetically with granites and gabbroitic eruptives. The iron ores in veins are supposed by Vogt[5] to be due to contact action between granite and the surrounding rocks. Those connected with the gabbros are basic accumulations, whose origin is ascribed to differentiation of the basic magma. In consequence of this differentiation, which is governed largely by Soret's principle and the differences in density of the various differentiated products, the gabbro splits into labrador-rock and various iron-olivine and iron-pyroxene compounds, and in these latter are accumulations of magnetite and ilmenite large enough to constitute ore bodies.. Each of the iron-pyroxene rocks is described by the author and the iron ores associated with them are characterized. The titanium of the iron is thought to have originated mainly in the olivine and other basic components of the normal gabbro.

The Tonalites of the Rieseferner.—The tonalites of the Rieseferner in the Tyrol are again the subject of careful petrographical study.[6] The normal tonalite (hornblende–mica–quartz–diorite)

---

[4] Amer. Jour. Sci., XLVII, 1894, p. 341.

[5] Geol. Fören Stock. Förh. 13 and 14.

[6] Becke: Min. u. Petrog. Mitth., XIII, p. 379.

which is a coarse granular rock, on its periphery often becomes finer grained and porphyritic. Large biotites and hornblendes are scattered through its groundmass, which remains fine grained, and the rock thus takes on a prophyritic habit. At other times the decrease in the size of its constituent grains is accompanied by a decrease in the proportion of plagioclase and quartz present in the rock and a large increase in the orthoclase present, while hornblende disappears completely. It is unnecessary to give the petrographical details of the author's paper. It should be mentioned, however, that the feldspars are very carefully studied by comparing the differences in their refracting indices, and many new points are brought out concerning their relations to each other. Some of the plagioclases were found to consist of nuclei of basic plagioclase, enclosing areas of a more acid feldspar identical with an acid peripheral zone. The phenomenon is thought to be due to corrosive influences. In addition to the various phases of the tonalite mentioned, the author makes a careful study of the veins cutting them, and of the slight alterations they have suffered and he refers to the existence of gneiss fragments occasionlly met with in their peripheral portions.

Petrographical News.—McMahon[7] cites, as evidence in favor of the eruptive character of the Dartmoor granite, and in opposition to the view of Ussher that it resulted from the fusion by pressure of preexisting pre-Devonian sedimentaries, the following facts. Its apophyses cut the surrounding rocks. The metamorphic changes effected in the latter are the result of contact action. Finally the other rocks with which the granite is associated show no evidence of the great pressure, to which they must have been subjected if the granite were truly a fused sedimentary.

Associated with the argillites, graywackes and other sedimentary rocks of the Keewatin series near Kekaquabic Lake in Northeastern Minnesota, Grant[8] has discovered volcanic fragmentals and amphibole schists, the former of which are recognized as diabase tuffs and the latter as their recrystallized representatives.

A quartz bearing leukophyre variety of diabase porphyrite, forms intrusive layers in the Carboniferous schists at the Hernitz Mine near Saarbrücken in the Pfalz.[9] The rock was regarded by Weiss as a melaphyre.

[7] Quart. Journ. Geol. Soc., XLIX, p. 385.

Proc. Somerset Arch. & Nat. Hist. Soc., Vol. 28, p. 892.

[8] Science, XXIII, 1894, p. 17.

[9] Laspeyres: Corr. Blatt. Naturh. Ver. Bonn., 1893, p. 47.

The tuffs found with the nepheline leucite basalts of the Dauner region in the Eifel are made up of augite, mica, and olivine fragments, augite crystals, glass particles and lapilli cemented together by quartz and felspar which represent an original glassy cement.[10]

On the west coast of the Island of Celebes, Wichmann[11] finds boulders of an epidote glaucophane-mica schist, supposed to be associated somewhere in the interior of the island with mica quartzite.

---

[10] L. Schulte: Verh. d. Naturh. Ver. Bonn., 1893, p. 295.

[11] Neues Jahrb. f. Min. etc., 1893, II, p. 176.

BOTANY.[1]

Abnormal Plant Growths.—*Trillium grandiflorum* Salisb., is noted for its variableness, but a specimen brought in by one of our pupils, this spring, exceeds anything I have seen in this respect. The flower is double, having two sets of sepals, and two of petals. Both sets of sepals are of the usual form and color. The outer petals are striped like ribbon-grass, except the half of one which is white. The inner ones are white, except a thread of green through the center of one. There are three stamens—one normal, one a filament without an anther, and the other expanded into a half-sized petal, concave on one side where a thread of gold, about the length of the anther, seems to be holding loyally to duty. The ovary is of usual size, the styles rather small—one smaller than the others. Near the top of one of the carpels arises an outgrowth about half an inch long, white, doubled together, and drawn over at the top like a hood. To add to the general confusion, there are, on the edges of this growth near the top, two pollen-bearing lines about an eighth of an inch long.

A member of my botany class, Mr. Cheshire Boone, found a specimen of *Hepatica acutiloba* DC., with two flowers on one scape. The second flower arises from the axil of a linear bract a little above the middle of the scape. It is on a peduncle an inch long, and is about half the size of the upper flower.

Another unusual form found this spring is *Viola palmata* L., var *cucullata* Gray, with all of the petals emarginate.

State Normal School, Lucy A. Osband.
Ypsilanti, Mich., May, 1894.

The Approaching Meeting of the A. A. A. S.—The meeting of the American Association for the Advancement of Science, this year, from August 15th to 24th, promises to be of great interest to botanists. It is to be held in Brooklyn, N. Y., within a few hours' ride of the homes and laboratories of probably one-half of the working botanists of the country, which may be counted upon as insuring a large meeting. Added to this is the fact that at this time will occur the first meeting of the American Botanical Society, which must attract many of our most earnest workers.

---

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

The Completion of Coulter's Texan Flora.—Within a few weeks, botanists have received copies of Part III of Dr. John M. Coulter's "Manual of the Phanerogams and Pteridophytes of Western Texas," published by the Department of Agriculture, as one of the Contributions from the U. S. National Museum. A glance over its pages shows it to be an important contribution to North American botany, covering, as it does, a region whose botany has hitherto been scattered through many different reports and papers. That the work is well-done, need not be said of anything from the masterhand of Dr. Coulter, who has here again shown his ability to make a much needed book. This volume carries southward the area covered by Coulter's "Rocky Mountain Botany," and gives to the author a kind of "preemption right" to a belt of botanical territory stretching from the Canadian line on the north (N. Dakota, Montana and Idaho) to the Mexican boundary on the south (Texas and New Mexico). It will clearly be his duty to enlarge his "Rocky Mountain Botany," so as to take in the territory of this Texan Flora; then by adding the Arizona-Nevada region, make it cover the whole of the Western Highlands, from about the 100th meridian to, but not including, the Pacific Coast Region. Such a "Botany of the Western Highlands" would, on many accounts, be much more likely to be successful than the two or three manuals which it now seems probable we are to have for this region.—CHARLES E. BESSEY.

ZOOLOGY.

An Australasian Sub-family of Fresh-water Atherinoid Fishes.—Mr. J. Douglas Ogilby, of the Australian Museum, of Sydney, has recently sent me a photograph and description of a new species of a genus called *Aristeus* by Castelnau. This genus is of much interest from a morphological as well as geographical point of view. Mr. Ogilby has asked, "Is it an Atherinid and allied to *Nematocentris?* or should a new family be formed of it?" Mr. Ogilby, unlike the original describer, is quite happy in his appreciation of its affinities.

The genus *Melanotænia* was proposed by Gill in 1862 (Proc. Acad. Nat. Sci. Phila. 1862, p. 280) for a fish called *Atherina nigrans* by Richardson, and was subsequently renamed *Nematocentris* (Peters, 1866), *Strabo* (Kner & Steind, 1866), and *Zantecla* (Cast., 1873). It has been generally referred to the *Atherinidæ*, but Kner and Steindachner were disposed to associate it with *Pseudomugil* in their family *Pseudomugilidæ*, and Castelnau proposed a new family, *Zanteclidæ*, for it. No satisfactory family characters were given.

The genus *Aristeus* was described by Castlenau in 1879, and by him referred to the family *Gobiidæ*. Steindachner, in a notice of the genus (Zool. Jahresber. 1879, p. 1061), happily hit at its relations in the words, "*Aristeus* N. G. Casteln. (wahrscheinlich.=Nematocentris, d. Ref.)."

There are two specially interesting features of these genera.

(1) They deviate from the typical Atherinids in the elongated anal fin which advances far forward, and with the advance are coordinated an advanced position of the anus and of the ventral fins, whose roots are little behind the bases of the pectoral fins.

(2) The species of both genera are confined to the fresh-waters of the Australasian realm and the constituent group is thus one more of the groups limited to a single realm.

The deviations of the genera from the typical *Atherinidæ* appear to be sufficient to warrant their segregation in a peculiar sub-family which may be named *Melanotæniinæ*. But confirmation by anatomical characters are very desirable. The sub-family may be defined provisionally, as follows:

MELANOTÆNIINÆ. Atherinids with a spinous dorsal, whose foremost spine is robust and rest weak, a very long anal, and thoracic

ventral fins. Inhabitants of the fresh waters in the Austrogean (Australasian) realm.

The genera may be differentiated as follows:

MELANOTÆNIA. Melanotæniines with a little compressed fusiform body, slightly curved dorso-rostral contour, and a blackish lateral band.

RHOMBATRACTUS. Melanotæniines with a much compressed rhombo-fusiform ventradiform body, emarginate dorso-rostral contour, and no distinct lateral band.

Aristeus having been used in 1840 by Duvernoy for a genus of Crustaceans, is unavailable for the group so-called by Castelnau, and *Rhombatractus* is used as a substitute.

Rhombatractus has a curious superficial resemblance to a toxotid on account of its compressed body, declining back and ventradiform contour, but the head is that of an atherinid.

It may be that the Melanotæniines should be accorded family rank, but further data are desirable before such a claim is recognized. One of the subordinal characters of the Percesoces, in any case, must be modified to fit these fishes.—THEODORE GILL.

EMBRYOLOGY.[1]

Earthworm Phylogeny.—The great accumulations of anatomical facts that the study of exotic earthworms has brought into existence during the past few years is now to be made more intelligible by the added facts of comparative embryology. It is a fitting tribute to one who has inspired so much of this recent exploration into this field that Bourne's paper[2] upon the development and anatomy of certain Indian earthworms should appear in the complimentary number of Lankester's Quarterly Journal.

When the study of exotic earthworms had shown that there might be large numbers of micro-nephridia present in any segment and when it was even claimed that tubules of these micro-nephridia might anastomose to form a connection from segment to segment, the view of Lankester became less tenable as it became more probable that the ancestral condition of the earthworm was not what the common European earthworm had led one to expect.

It seemed probable that the ancestor of the earthworm might have had a large number of nephridia and of setæ and no definite segmental arrangement of these structures.

Now, however, we learn from Bourne's paper that in the development of *Mahbenus imperatrix* and *Perichæta* the vexatious micro-nephridia arise as out-growths from provisional mega-nephridia and are thus of apparent secondary value. The ancestral condition of a pair of nephridia for each segment being clearly indicated even in these cases. The connection of nephridial tubes, the so-called "plecto-nephric" condition does not, apparently, exist at all, certainly not in the embryo.

We learn also that in these exotic forms, such as Perichæta (which is common with us in green-houses) the large number of setæ found in a band around each segment are not to be regarded as of ancestral value since they all arise from two germ bands that then give rise to matrices which grow laterally in each segment and form the numerous setal sacs by segregation of cells and by division of matrices. The setal germ bands in turn are regarded as probably arising from Wilson's lateral teloblastes.

Besides thus throwing much light upon the probable ancestral con-

---

[1] Edited by E. A. Andrews, Baliimore, Md., to whom contributions may be sent.

[2] A. G. Bourne. Q. T. Mic. Anat., April, 1894.

dition of seta of nephridia in the earthworm group the author's more detailed future work promises to add to our knowledge of other difficult points, such as the origin of the nerve cord, which it is here stated arises from two distinct matrices.

Bourne is inclined to regard the germ bands as the source of all the metameric structures. The body wall muscles would be of other origin. The segmentation of the digestive tract a secondary state forced upon it by the mesoblastic structures.

Determination of Sex.—What at first sight appears to be an interesting and valuable addition to the facts tending to show that favorable conditions lead to the production of female offspring and unfavorable conditions to the production of male offspring is to be found in a paper by F. Braem[1] upon the development of a marine polychætous annelid, *Ophryotrocha puerilis.* Here, however, as in some other cases, the evidence is really of little value as may be seen from the facts given by Korschelt in a paper immediately following that of Braem.

Braem found in attempting some regeneration experiments in addition to his study of the ovaries and testes that in one case there was a remarkable change of sex. A female annelid full of ripe eggs was cut into two pieces, the anterior containing 13 and the posterior 22 segments. After three weeks the anterior part had regenerated seven segments.

It had become smaller and appeared to be starving while the eggs had disappeared. When sectioned it was found to have changed its sex, containing only testes. A few cells remained that were ova in process of formation before the sexual glands changed their character and began to form sperms.

The author would refer this transformation into a male to the unfavorable conditions, to the fact that the creature was not sufficiently nourished to form ova as well as to regenerate the lost part of its body.

Now Korschelt in a careful study of the anatomy of this same small annelid finds that besides males and females, there are also hermaphrodites (in fact Braem found one such case) in which the same gland makes both ova and sperms. Among 30 individuals 6 were female, 7 were male, 8 were apparently female but contained male cells both young and full formed, white the remaining 9 were apparently male though containing ova in the testes. Thus the hermaphrodite state is the more frequent one, to judge from these few cases.

---

[1] Zeit. f. wiss. Zool., 57.

Though there is no evidence that the male and female states may normally succeed one another in the same animal, yet when this, apparently, was the case in one specimen operated upon by Braem, we are not justified in regarding this is as a result of the operation or as in any way connected with it, since it may be that it would have taken place under the normal conditions. Moreover, and this is more important, the animal full of eggs may very well have been a hermaphrodite from the first, and have merely re-absorbed its ova under the stress of regeneration, so that we know nothing as to any real change from female to male in this case.

PSYCHOLOGY.

Mutualists.—Many animals which are found associated with other animals and which are usually termed parasites are, in fact, true mutualists. I mean by the term, mutualist, an animal which gives a *quid pro quo* or specific beneficial service to the host which affords it sustenance and domicile. A true parasite feeds on the food or the physical juices and structures of its host without rendering any reciprocal service whatever. Thus, the family *Pediculidæ* (*P. corporis*, *P. capitis*, *etc.*), found associated with man, are true parasites, while the family *Ricinia*, found associated with birds, are true mutualists. I am fully aware of the fact that I antagonize the opinions of entomologists (who regard all these little creatures as parasites which are to be destroyed as soon as discovered, inasmuch as they consider them detrimental to the health of the animals upon which they are found), for I consider most of them absolutely necessary to the health and well-being of their hosts, and their absence to be an indication of disease in some form or other in those animals on whose bodies they are not to be found. Careful observation has taught me that these faithful little hygeinic servitors immediately abandon the bodies of fowls which are the victims of cholera and kindred diseases. Porcine mutualists behave in a like manner when their hosts become diseased. I had thought with others until recently, that these corporal scavengers and toilette assistants were parasites, but systematic and painstaking observation has taught me otherwise. In the first place, microscopic examination shows that these creatures have no suction apparatus like fleas (*Pulex*) and lice (*Pediculus*) for the purpose of sucking up the blood and juices of their hosts. Their jaws are usually armed with a simple pair of incurvated scrapers with which they scrape the surface of their hosts' bodies. Their stomachs never contain the blood of their hosts, but are always filled with exfoliated epithelium and kindred superficial debris. Supported by these observations alone, the fact at once becomes evident that these creatures are not true parasites ; but there is yet more testimony to be adduced in favor of these hitherto maligned coadjutors and promotors of animal hygiene. If one carefully separates the feathers on the body of a fowl and uses a good lens (10 diam.) he may observe *Liothe pallidum*, a true mutualist, busily engaged in removing exfoliated epithelium (scarf-skin) from the body of its host. It thoroughly cleans its allotted area, scraping away and swallowing

all of the waste products of the skin. Again, if the feathers themselves be examined, another mutualist (*Liothe eaculatum*) may be seen freshening and beautifying their sheen by taking into its stomach all dead epithelial cells, etc., with which it comes in contact. Mutualists are found everywhere in nature, and wherever found are of essential service and benefit to the animals possessing them. From the giant cetacean to the microscopic rhizopod, from the savage lion to the timid field-mouse, from the kingly eagle to the tiny humming bird, no animal is without them. Butler's epigram:

> "Big fleas have little fleas upon their backs to bite 'em;
> And these fleas have other fleas and so *ad infinitum.*"

is mainly true, only I insist that no true mutualist ever bites its host. Many mutualists never reside wholly with their hosts, but visit them occasionally to render them needful service. The famous crocodile bird visits its host in order to pick its teeth; Buphagus, the surgeon of the buffalo, alights on the back of its host, and, with its sharp, lance-like beak opens the cells of encysted larvæ and removes them; the European starling performs a like service in removing "wolves" from the backs of cattle.

In matters of the toilette many animals are entirely dependent on the ministrations of mutualists. This is notably the case with many of the fish family. I placed two gilt catfish, whose skins had been thoroughly cleaned with a solution of salt water and borax, in a tank of filtered water in which there were no *Gyropeltes*, the mutualists of this species of fish. In two days their skins had lost their beautiful golden sheen and had become dull and lusterless. The fish themselves clearly showed by their actions that they were not in good health. They remained at the bottom of the tank almost without motion. I then took them out and found that their skins were covered with a slimy mucous exudate. I placed them for a few moments in a tank of pond-water in which there were multitudes of *Gyropeltes*. After allowing them to remain in this tank for a few moments, they were removed and examined, and thousands of these mutualists were discovered greedily devouring the mucous. After a day's residence in the pond water their skins had recovered all their lustre and beauty, and the fish showed by their actions that they had regained their health. A truly remarkable mutualist is found associated with the crayfish. It belongs to the genus *Histriobdella*, and its office is analagous to that of the vulture, the jackal, and the burying beetle which remove carrion. It is exceedingly agile and is altogether one of the most unique in appearance of all animals. It may be described as a two-legged

worm, which has all the powers of a most accomplished contortionist. The crayfish, after oviposition, carries its eggs beneath its tail, and the *Histriobdella* lives among them. Its office or function is to devour all blighted or unimpregnated eggs and dead embryos, the decay of which might affect the health of its host and progeny. Van Beneden, describing the *Histriobdella* found associated with the lobster, says: "Let us imagine a clown from the circus, his limbs dislocated as far as possible, we might even say entirely deprived of bone, displaying tricks of strength and activity on a heap of monster cannon balls, which he struggles to surmount; placing one foot formed like an air-bladder on one ball, the other foot on another, alternately balancing and extending his body, folding his limbs on each other, or bending his body upward like a caterpillar of the family *geometridæ*, and we shall then have but an imperfect idea of all the attitudes which it assumes, and which it varies incessantly." I once saw one of these little animals stand erect on its legs, then bend its body down between them and, with a quick flirt, turn a complete summersault. I have repeatedly seen this mutualist insert its proboscis into the eggs of crayfish and devour them. Microscopic investigation always showed that the eggs thus attacked were unimpregnated, consequently unfertile. I might prolong this paper by introducing many other mutualists, but think it hardly necessary. I have shown that these creatures subserve a very useful purpose in nature, and that they do not belong to that disreputable class—the parasites.—Jas. Weir, Jun., M. D.

ARCHÆOLOGY AND ETHNOLOGY.

Ancient American Bread.—Mr. S. P. Preston, of Lumberville, told me on April 1st, 1894, that he remembered his grandfather, Silas Preston, telling him how the latter, when a boy living on the farm now owned by Benjamin Goss, in Buckingham township, Bucks County, Pa., had seen Delaware Indians, about the year 1780, encamped in barked-roofed wooden huts near by, pound corn in stone mortars with stone pestles. They mixed the meal with water, and patting the dough into flattened balls with their hands, baked these cakes in the hot embers of their open fires. He did not tell his grandson whether they salted the meal, or—what was more important, if we want to try the experiment—whether the corn grains were pounded when old and well dried, which would be a difficult operation; when green and soft, which would be easier, or after previous parching, which would be easiest of all.

Franklin (Harshberger on Maize, p. 140) speaks of Indians, probably Delawares, parching corn grains in dishes of hot sand and afterwards grinding them to a fine powder, which kept fresh a number of years. Captain John Smith saw Indians roastiug corn on the ear green, and when thus parched crisp, bruising it in a "wooden mortar with a polt and lapping it in rowles in the leaves of their corn, and so boyling it for a dainty."

Parching loose grains well stirred in an open iron dish does as well as either of the above methods in my experience and gets over the first and main difficulty of producing the meal or dough with a stone mortar and pestle. This meal, as I have made it, from freshly parched grain, is the easily produced Mexican Pinol, carried invariably on long desert journeys in Chihauhua and Sonora—sometimes seasoned with herbs or parched cocoa shells and generally mixed with sweetened water as a strengthening beverage.

The taste of cakes made of parched meal, I find on experiment, differs as much from that of others made from fresh grain as it does from the flavor of bread made by Mexican Indians from Metate crushed grains previously softened in hot lime water; but, given the meal, the Lenape process of cooking the dough in the embers of an open fire is that to-day in use by the negroes of Southern Maryland and Virginia. In an ash cake baked in the embers before me at Egglestons', Giles county, Virginia, in February, 1894, they reproduced the mode of the

Lenape cook, while with their hoe cakes, originally baked by the cornfield hands on hoe blades thrust into the wattle and clay fire places in log cabins, another Indian cake, that cooked on flat heated stones is imitated.

The Lenape word "Pone" (pronounced by the Delawares *ach pone*, and meaning baked corn bread), much used in Virginia to mean all kinds of corn bread, including the Johnny cake (baked on a greased board like a planked shad), is not needed to show that maize bread cooking—the best of it on the Atlantic seaboard, is a direct inheritance from the Indian.

Virginians justly despise all corn bread made north of Mason and Dixon's line. We use red corn instead of white, say they, which spoils the flavor, grind the meal coarse, which spoils the grain, and lastly, bake the meal (sometimes at mills) to save the frequent grinding necessitated in the South (once a week in summer and once in three weeks in winter) to prevent fermenting which destroys the vitality.

These alleged reasons may not fully account for the abominable corn bread of the North, but it is possible that the Indians had developed valuable modes of preparing the grain of their great plant, which neither Virginian nor Northerner have understood.—H. C. MERCER.

The making of New Jersey Coast Shell heaps in 1780.—To learn from Mr. Preston that even these squatting, half-civilized Lenape, in Buckingham, as lately as 1780, went over to the sea to make shell heaps once a year, is to lessen our surprise at the man-made shell deposits of the New Jersey coast, for if these conspicuous remains of shell feasts were built up, not only by coast-dwelling tribes, but by an Indian population from a good range of interior country, we need not wonder that they are very large or suppose that they are very old.

The Indians were in the habit of going in a body several days' walk, said Mr. Preston, the elder, in April or May to the clam banks of the New Jersey coast, near New Brunswick. There they encamped for several weeks to feast on clams, and when they retnrned, brought to the old and infirm who had remained at home, bundles of clams slung in skins on pairs of poles running from shoulder to shoulder of two men.

Even their stone-pointed arrows were sometimes used, at that time by these tolerated stragglers, who had sold the land they lived on in 1737, as when during mowing season, they shot robins and "flickers" (golden-winged woodpeckers) in black cherry trees with bows and arrows and strung the birds on long cords. Land turtles

were cooked for food, as when Mr. Preston saw a woman throw an *apron* full into an open fire, while another poked the tortured creatures back into the coals with a pole till they were roasted. It was remembered as a good joke that during a boiling of lye and soap fat for soft soap, an Indian woman coming to the kettle in the absence of the cooks, was seen to grease her hair with the mixture.—H. C. MERCER.

The Hemenway Collections.—The trustees of the Peabody Museum of Ethnology, in Cambridge, received a letter from Mr. Augustus Hemenway offering them, on behalf of the trustees of the estate of Mrs. Mary Hemenway, the incomparable collection of archeological specimens gathered during the last seven years by Mr. Frank H. Cushing and Dr. J. Walter Fewkes in Arizona and New Mexico.

These collections are not offered as a gift, but merely as a deposit. The trustees of the museum have accepted the loan, and have offered a sufficient space for its display. It is probable, however, that the deposits will amount practically to a gift.

A condition of this deposit is that Dr. J. Walter Fewkes, who has been in charge of Mrs. Hemenway's archeological enterprises since Mr. Cushing was compelled, on account of continued ill-health, to retire, shall continue in charge of the collection, although, of course, under the direction of Prof. Putnam, the curator of the museum.

The collection, which may be divided for convenience's sake into two parts, that formed by Mr. Cushing and that by Dr. Fewkes, is now widely scattered.

The portion excavated in the vicinity of Phenix and Tempe, Ari., by Mr. Cushing, is at present stored in Salem, Mass., while some of the results of Dr. Fewkes' expedition to the Moqui Indians of New Mexico are stored at 42 Mt. Vernon Street, Boston, and the rest are on exhibition in the National Museum in Washington.

How soon these portions will be united in Cambridge has not yet been decided, but it is reasonable to suppose by next fall there will be a fairly complete display open to the public at the Peabody Museum.

The indirect cause of these collections was the explorations which Mr. Cushing carried on among the Zuñis of New Mexico. The Zuñis seemed to Mr. Cushing to possess remnants of certain customs and habits which might possibly be referred back to the prehistoric inhabitants of the ancient pueblos or towns, the big, low, communal buildings which lie in ruins throughout the southwestern part of the United States.

A thoroughly equipped expedition, the entire expenses of which were paid by Mrs. Hemenway, who had become interested in Mr. Cushing's project, started for Arizona in 1887. For three years a most thorough,

careful and scientifically conducted expedition was carried on among these pueblos under the direction of Mr. Cushing.

The collection of specimens, including almost every variety of prehistoric implement, utensil and ornament in use among the ancient dwellers, which Mr. Cushing obtained is the most valuable ever carried out of Arizona. There is nothing from the same region comparable to it anywhere. Even more valuable are the facts which Mr. Cushing was enabled to learn from his explorations about the life and religious habits of this heretofore mysterious race. As yet, however, the facts have not been published by Mr. Cushing, who, since his illness, has been employed by the national government.

The explorations of Dr. Fewkes were made during the summers of 1890, 1891, 1892 and 1893. They were confined exclusively to the Moqui and Zuñi tribes.

Much attention was paid to the religious ceremonies of the Zuñis. A set of phonograph cylinders, recording their religious songs, was obtained during the summer of 1890. The cylinders, of course, are preserved in the Hemenway collection.

A year or so later the magnificent Keam collection was acquired by purchase. Keam had been a trader among the Moqui Indians for twenty years. Like most Indian traders, he had acquired a collection of utensils and religious paraphernalia, collected with an idea to sell at some future day. He had refused to sell single pieces, keeping the whole lot intact for some future purchaser. Every specimen was labeled with a short description. In its numbers are included both ancient and modern articles—blankets, basket ware, religious and household pottery, kilts, dolls (which are made in the likeness of idols, serving as a sort of kindergarten instruction to the children in religion), in fact, almost every type of old and new, of everything in use among the Moquis and their predecessors. Not only is the collection the best in the world, but it must always remain so, for the Moquis have by this time become sophisticated by white civilization. Added to this Keam collection are the valuable supplementary collections gathered by the Hemenway expedition itself.

Thirty-five hundred specimens were beautifully arranged in the exhibition held two years ago in Madrid to commemorate the four hundredth anniversary of the discovery of America. These specimens were intended to illustrate the habits of the natives of New Mexico at the time of the landing of Columbus. They gained Mrs. Hemenway a personal letter of thanks from the Queen of Spain, and their curator the decoration of the Order of Isabella the Catholic.

MICROSCOPY.[1]

New Method of Imbedding in a Mixture of Celloidin and Paraffine.[2]—Messrs. Field and Martin recommend the following method as an improvement on those proposed a few years ago by Ryder and Kultschizky. The method permits of imbedding the object directly in a mixture of celloidin and paraffine. The mixture is prepared by using as a solvent, alcohol and toluol (toluène); the latter, taking the place of ether, makes it possible to dissolve paraffine in the celloidin solution. Proceed as follows:

1. Make a mixture of absolute alcohol and toluol in equal parts.

2. Soak some dry celloidin in toluol; after some hours, add a little of the alcohol-toluol.[3] The celloidin swells up and dissolves. The solution should have about the consistency of clove oil.

3. Finally, add to this mixture some shavings of paraffine, obtained by scraping the surface of a block of this substance with a scalpel. In order to hasten the solution and increase the proportion of paraffine the mixture may be heated a little. Above 20° to 23°, one runs the risk of precipitating the celloidin, which separates in a transparent granular mass.

These mixtures prepared, the process of imbedding is executed in the following manner: The object, taken from absolute alcohol, is placed in the alcohol-toluol. It is easily and quickly saturated, and is then placed directly in the imbedding mixture. The penetration is more rapid than in the ordinary celloidin solution. As soon as saturation is complete, one may proceed to solidify the celloidin. This may be done in two ways:

1. The object is transferred to a saturated solution of paraffine in chloroform, and when the solidification is complete (2–3ds.), the imbedding paraffine is carried out according to the well known method Bütschli.

---

[1] Ed. By Prof. C. O. Whitman, University of Chicago.

[2] Bull Soc. Zool de France, XIX, p. 48, Mar. 13, 1894, and Zeitschr. f. wiss. Mikr., XI, 1, 1894.

[3] The alcohol-toluol is added after the tuluol has been turned off. About 45cc is enough for 1 grm. of celloidin. This solution will dissolve about ½ grm. of paraffine (melting at 56°) at ordinary room temperature.

2. The object is placed in toluol containing some paraffine in solution. The alcohol diffuses in the excess of toluol, and the celloidin solidifies. Imbed as before.

In both cases care must be taken to avoid shrinkage, which occurs if the celloidin is solidified in pure paraffine.

The object thus imbedded in paraffine is sectioned in the usual way. The ribbons of sections are fixed to the slide by means of the ordinary albumen fixative, or by the aid of pure water. In the latter case, the strips cut to the length desired are placed on a clean slide slightly wet with water. Then a little water is added by means of a brush, just enough to barely float the sections[4] The slide is then heated so as to soften the paraffine without melting it. The sections expand readily. It remains only to drain off the water and let the slide dry completely.

If desired the celloidin may be removed by the mixture of alcohol and toluol which dissolves at once both the paraffine and celloidin. Then, after washing with toluol, the sections may be mounted in balsam in the usual way. If they are to be colored on the slide, they should be washed with alcohol and water.

On the Fixing of Paraffine Sections to the Slide.—A combination of the water method of Suchannek and Heidenhain with the albumen method of Mayer has been found very useful as it does away with the slow-drying of the former method and still permits the ready arrangement of the sections and their expansion and flattening.

A slide, cleaned with only ordinary care, is covered by means of the finger with the least possible amount of Mayer's Albumen. By means of a small brush the upper surface of the slide is then flooded with water and the brush, still slightly wet, is used for picking up and arranging the sections or ribbons. The brush may then be used for removing the excess of water, and the slide slightly warmed for a few moments on a water-bottle, care being taken that the sections do not melt. The sections soon expand and float upon the water which should be drained away and slide placed a second time upon the water-bath. After remaining about fifteen minutes the paraffine may be melted and the slide plunged into turpentine or some other solvent of paraffine.—H. C. Bumpus, Marine Biological Laboratory, Woods Holl, Mass.

[4] The following note by Dr. Bumpus suggests an improvement.

SCIENTIFIC NEWS.

The work of the Michigan Fish Commission in 1894.—After a careful study of various points along the coast, Charlevoix has finally been decided upon as the location for the work of this year. It lies on the eastern shore of Lake Michigan just north of Grand Traverse Bay, within easy reach of numerous white fish spawning and fishing grounds. Extensive fishing operations are carried on here throughout the year, and varied conditions of shore and bottom are to be found within easy reach. Opposite this point Lake Michigan reaches a depth of 850 feet, and shallow water with reefs and islands are not far distant. Numerous inland lakes of varying size are also readily accessible and the variety of conditions is unsurpassed by any point on this shore. In addition to this the Commission has already at Charlevoix a hatchery which will furnish extensive aquaria for keeping specimens alive and for experimental work. A carpenter shop next door to the hatchery building has been rented for the summer and fitted out as a laboratory, with tables, shelves, reagents and the necessary apparatus. The University of Michigan co-operates with the undertaking as in former years, and has renewed its loan of apparatus and of a special library. Several boats, including a small steamer and all kinds of nets for shallow and deep water work and for bottom and surface collecting, are at the service of the party.

The work will include a determination of the fauna and flora of Lake Michigan at this point and of their vertical and horizontal distribution. This determination will be both qualitative and quantitative, and will be particularly directed towards a study of the life history of the white fish and lake trout. Since the life of the water constitutes, first or last, the food of the fish in it, this determination will afford some idea of the value of this locality as a breeding ground for fish and of its adaptability as a planting ground for the fry. The temperature, transparency and purity of the water and the character of shore and bottom, as well as the currents and connecting lakes will receive attention as problems which affect most powerfully the welfare of the fish.

The party at work in the laboratory will consist of Professor Henry B. Ward, University of Nebraska, Director; Professor E. A. Birge, University of Wisconsin; Professor C. Dwight Marsh, Ripon College, Wisconsin; Dr. Charles A. Kofoid, University of Michigan; Dr. Robert H. Walcott, University of Michigan; Mr. Herbert S. Jennings, University of Michigan; Mr. Bryant Walker, Detroit, Michi-

gan. In addition to these, a number of specialists will be guests of the Commission for a longer or shorter interval.

The laboratory will be open during July and August, and visiting scientists will be accorded a most cordial welcome. To a certain extent it will be possible to offer the privileges of the laboratory to specialists who may wish to carry on investigations on special groups. Notice of such cases should be sent to the director as early as possible, that the necessary arragements may be made.

The Biological Station of the University of Illinois.—The field operations and the resources of the natural history departments of the University, especially those of zoology and botany, have been notably increased during the last term by the establishment, April 1, on the Illinois River, at Havana, of a biological station devoted to the systematic and continuous investigation of the plant and animal life of the waters of that region. This establishment, authorized by the trustees of the University at their March meeting, is under the direction of Professor Forbes, with Mr. Frank Smith, assistant in zoology, in immediate charge of the work. Mr. Adolph Hempel and Mrs. Smith also work there continuously, with an expert fisherman as factotum.

The field work is now done from a cabin boat, chartered for the summer, which carries the seines, dredges, surface nets, plankton apparatus, and other collecting equipment, together with microscopes, reagents for the preservation of specimens, a small working library, a number of special breeding cages for aquatic insects, and a few aquaria. This boat is provided with sleeping accommodations for four men, and with a well-furnished kitchen.

In Havana itself are office and laboratory rooms supplied with running water and electric light, and provided with the usual equipment of a biological laboratory, consisting of first-class microscopes, microtomes, biological reagents, etc., and tables for five assistants. Professor Forbes and Mr. Hart, of the state laboratory of natural history, visit the station frequently for special lines of work.

The boat is established in Quiver Lake, an elongate bay of Illinois, two and a half miles above Havana. At low water this lake is about two miles long with a steep sandy bank some fifty feet high on the eastern side and a mud flat on the western. The banks are wooded, on the east mostly with oak and hickory, and on the west with the lowland species. The locality is beautiful and healthful, and the water excellent.

From the lake and the river selection has been made of a number of

typical situations, and from these, and from Phelps and Thompson Lakes a little distance away, collections of all descriptions are made at regular intervals for a comparative study of the organic life—the relative abundance of the species at different seasons of the year, and the general system of conditions by which it is affected.

The plan of operation contemplates continuous work at this station for several years, with especial reference to the effect of the enormous overflow and rapid retreat of waters characteristic of the Illinois and the Mississippi system generally. Continuous studies are made of the food of all the species collected, with final reference to the feeding habits and food resources of the native fishes of the region. Temperatures are taken daily, and analyses of the waters of the lake and river at the various stations are being made at regular intervals by the chemical department of the University.

This station will be held open for graduate students in zoology and botany wishing to take their advanced degrees in zoological or botanical lines. Such students, choosing to pursue their studies at Havana will be furnished with every facility for the original investigation of a large variety of subjects, and arrangements will be made by which the other studies of their postgraduate courses may be carried forward without embarrassment.

The station is further capable of sufficient expansion to accommodate other investigators from the University and from the University summer school, for whose benefit excursions will be arranged as may be found profitable.

This is the first inland aquatic biological station in America manned and equipped for continuous investigation; and the first in the world to undertake the serious study of the biology of a river system.—*From the Illini, June* 6, 1894.

Cook's Excursion to Greenland.—The excursion to visit Greenland organized by Dr. Frederick A. Cook, anthropologist of Peary's first expedition, consists of fifty persons, of whom a good part are students of science. They have chartered the steamer Miranda and will sail directly for the far north, stopping at Cape Breton, and at two or three places in Labrador and Southern Greenland, reaching Inglefield Gulf about the first of August. Among the scientific members are Professor W. H. Brewer of Yale College, who will go the whole round; Professor B. C. Jillson of Pittsburg, Pa., who with Professor G. F. Wright and son, of Oberlin, O., and a party of six, will stop off in Umenak Fiord about latitude 71, to study the border of the ice sheet, the neighboring glacial deposits, the glaciers entering the

fiord, the Tertiary deposits of the vicinity, and make a collection of the plants ahd animals.

Professor L. L. Dyche, at the head of the department of Zoology and Taxidermy at the State University of Kansas, is the official naturalist of the expedition, and will go the full round. He will make a specialty of collecting Birds and Mammals. He will have under him Mr. S. P. Orth of Oberlin, O., botanist, and B. F. Stanton of Oberlin, assistant naturalist, to make general collections. Mr. E. A. McIlhenney of Louisana, goes as an ornithologist.

Professer C. E. Hite of Philadelphia with three assistants is to stop off in Labrador for general exploration. Professor E. P. Lyon of Chicago goes for the general student of biology. The expedition expects to return about September 20th.—G. F. WRIGHT.

The Forty-third Meeting of the American Association for the Advancement of Science, will he held in Brooklyn, New York, August 15 to 24, 1894. The following officers will be in charge:

President, Daniel G. Brinton, Media, Pa.

Vice-Presidents, A.—Mathametics and Astronomy, George C. Comstock, Madison, Wis.; B.—Physics, Wm. A. Rogers, Waterville, Me.; C.—Chemistry, T. H. Norton, Cincinnati, O.; D.—Mechanical Science and Engineering, Mansfield Merriman, South Bethlehem, Pa.; E.—Geology and Geography, Samuel Calvin, Iowa City, Iowa; F.—Zoology, S. H. Scudder, Cambridge, Mass. (Resigned); G.—Botany, L. M. Underwood, Greencastle, Ind.; H.—Anthropology, Franz Boaz, New York; I.—Economic Science and Statistics, Henry Farquhar, Washington, D. C.

Permanent Secretary, F. W. Putnam, Cambridge (office, Salem), Mass.

General Secretary, H. L. Fairchild, Rochester, N. Y.

Secretary of the Council, James Lewis Howe, Louisville, Ky.

Dr. August von Klipstein, formerly Professor of Mineralogy at Giesson, died, April 16, 1894, in his 93d year.

The news of the appointment of Sidney J. Heckson of Downing College, Cambridge, to the Chair of Zoology at Owens College, Manchester, will prove welcome to his many friends.

Science in Persia! The Shah has instituted a zoological garden.

Dr. Joseph Hyrtl, the anatomist, died, July 17, 1894. He was born on Dec. 7, 1811, at Eisenstadt, Hungary, and studied at Vienna, where he obtained, at the age of twenty-one, the position of preparator. He was chosen in 1837 as professor in the University of Prague, and

in 1845 returned to Vienna as professor of anatomy at the university there. In 1857 he became a member of the Imperial Academy of Sciences. He was one of Austria's most distinguished anatomists and the author of two works which have come to be accepted as standard authorities throughont the world—"The Manual of Physiological and Practical Anatomy" and "The Manual of Topographical Anatomy and Its Applications." Dr. Hyrtl, being very skilful in the art of preparing anatomical specimens, established in Vienna an anatomical museum, of which he published a most interesting description. He had enriched most of the anatomical collections of Europe with models of rare perfection. One of his collections, that of the skeletons of fishes, was purchased by Prof. Cope of Philadelphia. He was for a time director of the Ecole Superieure, resigning the position in 1874.

Dr. George Huntington Williams, professor of geology at Johns Hopkins University, whose death occurred in July, founded the department of mineralogy and geology at the Johns Hopkins in 1883, and since that time had acquired a wide reputation among scientific men for his intimate knowledge of the geology and topography of Maryland. He was also a collaborator of the United States Geological Survey, and prepared a number of special reports for the survey during his summer vacation. He was born Jan. 28, 1856, at Utica, N. Y. His connection with the Johns Hopkins dates from March, 1883, when he entered the university as a fellow by courtesy. In October of that year he was added to the faculty as an associate in mineralogy. In 1885 he was made an associate professor, and in 1892 was chosen to the chair of inorganic geology. His writings include nearly a hundred geological and mineralogical papers in scientific journals, more than one-half of which treat of the geology of Maryland, especially in the vicinity of Baltimore. He wrote "The Elements of Crystallography," and had been engaged for a number of years in preparing a new geological map of Maryland for the United States Geological Survey. He was one of the judges of the mines and mining exhibit at the World's Fair, an editor of the Standard Dictionary, recently issued, and of Johnson's Cyclopedia, now in press. He was a member of the National Academy of Sciences, a vice-president of the Geological Society of America, and a member of the American Institute of Mining Engineers, the Washington Geological Society and other scientific bodies.

Johannes Nill, founder of the Stuttgart Zoological Garden. died in that city May 20, 1894; his son, Adolf Nill, is his successor in the management of the garden.

THE
AMERICAN NATURALIST

VOL. XXVIII. September, 1894. 333

ON THE ORIGIN OF THE SUBTERRANEAN FAUNA OF NORTH AMERICA.

BY ALPHEUS S. PACKARD.[1]

Having, in my essay on the Cave Fauna of this continent, attempted to bring together as many facts as possible bearing on this subject, in now addressing the members of this Congress on the topic assigned me, it will be well to first give a *résumé* of the general subject and then to call attention to the additional facts and conclusions relating to this interesting topic.

In that work I took the view that the cave fauna of this country, and presumably of the world in general, was formed of emigrants or colonists from the surrounding regions of the upper world. I may be permitted to give an extract from what I published in 1888, in order to call attention to the scope of the inquiry.

"The conditions of existence in caverns, subterraneous streams and deep wells, are so marked and unlike those which environ the great majority of organisms, that their effects on the animals which have been able to adapt themselves to such conditions at once arrest the attention of the observer. To such facts as are afforded by cave-life, as well as parasitism, the philosophic biologist naturally first turns for the basis of

---

[1] Read at the meeting of the Zoological Congress of the World's Auxiliary Congress of the Columbian Exposition, Chicago, 1894.

his inductions and deductions as to the use and disuse of organs in inducing their atrophy. It is comparatively easy to trace the effects of absence of light on animals belonging to genera, families, or orders in which eyes are normally almost universally present. As we have seen in the list already given of non-cavernicolous animals, the eyes are wanting from causes of the same nature as have induced their absence in true cave animals. No animal or series of generations of animals, wholly or in part, loses the organs of vision unless there is a physical, appreciable cause for it. While we may never be able to satisfactorily explain the loss of eyes in certain deep-sea animals from our inability to personally penetrate to the abysses of the sea, we can explore caves at all times of day and night, of winter and summer; we can study the egg-laying habits of the animals, and their embryonic development; we can readily understand how the caves were colonized from the animals living in their vicinity; we can nicely estimate the nature of their food, and its source and amount, as compared with that accessible to out-of-door animals; we can estimate with some approach to exactitude the length of time which has elapsed since the caves were abandoned by the subterranean streams which formed them and became fitted for the abode of animal life. The caves in Southern Europe have been explored by more numerous observers than those of this country, and the European cave fauna is richer than the American, but the conditions of European cave-life and the effects of absence of light and the geological age of the cave fauna are a nearly exact parallel with those presented in the pages of my memoir. Moreover, the cave-life of New Zealand and the forms there living in subterranean passages and in wells, show that animal life in that region of the earth has been affected in the same manner. The facts seem to point to the origin of the cave forms from the species now constituting a portion of the present Plistocene fauna; hence they are of very recent origin."

The advances in our knowledge of cave-life made since 1886 and 1887, may be referred to under the following heads:

I. The fauna of caves, subterranean waters and wells, and their origin, investigated by H. Garman, Herrerao, Girard, Bolivar, Cope and Stejneger.

II. New facts regarding blind non-cavernicolous or lucifugous forms, comprising the anatomical and physiological investigations of Eigenmann, Hess, Kadyi, Schlampf, Ritter, and others.

III. Embryological observations on the conditions of the eyes in the young or in the embryos, tending to prove the origin of blind forms from normal eyed ancestors, by Teller and by Eigenmann.

IV. Theoretical discussions, by Weismann, Herbert Spencer, Lankester, and others.

I. It is very desirable to make a thorough survey of the animal life living at present in the region around the entrances of caves, in order to ascertain the eyed forms from which the blind ones may have originated. This Professor Garman has begun to do for the cave-region of Kentucky. In his article in "Science," on the origin of the cave-fauna of Kentucky," while he remarks that "the geological evidence is all that could be desired for proof of a recent origin of the caves themselves," he dissents "from the conclusions which have been drawn from this proof, as to the recent origin of the blind animals," claiming that animals which burrow in the soil everywhere show a tendency to loss of the organs of vision," and that "the originals of the cave species of Kentucky were probably already adjusted to a life in the earth before the caves were formed," and adds, "I cannot believe that there has been anything more than a gradual assembling in the caves of animals adapted to a life in such channels. In this view of the matter the transformation of eyed into eyeless species appears to have been much less sudden and recent than has been supposed." He illustrates his point by the "definite example of the blind crustacean, *Caecidotaea* (Asellus) *stygia*, which, though first discovered in caves, is also widely distributed in the upper Mississippi Valley, occurring as far east as Pennsylvania. "It is, throughout its range, a creature of underground streams, and is nowhere more common than on the prairies of Illinois

(the last place in the country in which one would expect to find a cave), where it may be collected literally by the hundreds at the mouths of the tile-drains and in springs. In Kentucky also it is not more abundant in the cave region than elsewhere, being very frequently common under rocks in springs and in streams flowing from them, even during its breeding season. It is only natural that such a crustacean should have found itself at home in Mammoth Cave when this cave was ready for its reception."

"I scarcely see what grounds there are for supposing that the present cave species are older than the remaining Quaternary fauna. All the blind and eyeless or partially eyed species must, in the beginning, have descended from normally-eyed forms, while the loss of vision or the disappearance of eyes, even where the rudiments of eyes remain, may, in some cases, have been comparatively sudden (by which we mean after several generations, or less, say, than a hundred), or in others have required hundreds of generations. In some cases, as in that of *Caecidotaea*, forms living in subterranean streams or under stones or buried in the soil, may have become already modified before being carried, or before migrating into the caves."

Mr. Garman then refers to the blind fishes, giving some new facts regarding their distribution. Finally he writes of the distribution of the blind beetles of the genus Anophthalmus, and gives an interesting account of a new species (*A. hornii*) discovered in fissures in the Trenton limestone of Lexington, Ky. This is an interesting example of the way in which a species living in conditions intermediate between an out-of-door life under stones or in the soil and in caves, becomes gradually adapted to a cavernicolous existence. The author also states his belief "that there appears to have been, after the Champlain period, a migration towards Mammoth Cave of cave insects from the south and east, when the continent had not been so greatly affected by changes of level as was the Mississippi Valley. Mr. Garman also sees nothing to indicate that cave animals have ever been more completely isolated than they are now, a view with which we agree. This does not conflict with the general

view we have expressed that isolation is an important factor in the evolution of the fauna of caves, of subterranean waters, and of other dark situations.

Other additions to our subterranean fauna have been noticed by Mr. S. Garman, who finds in the caves of southwestern Missouri, in which are subterranean streams, besides *Tiphlichthys subterraneus* Girard a new species of blind crayfish (*Cambarus setosus* Faxon); what "seems" to be *Ceuthophilus sloanii* Pack. and *Asellus hoppiae* Garman, "from Day's Cave, in mud under stones;" the latter form seems to be a genuine, eyed *Asellus*, and allied to an undetermined species represented on Pl. IV, fig. of our memoir, collected from a brook near Lancaster, Ky. The six other species of invertebrates mentioned belong to common out-of-door species, including a dragon-fly, a Dineutes, and a Hydrotrechus, and need not have been mentioned in connection with cave insects, as multitudes of insects naturally occur at or near the mouth of caves.

Here might be mentioned the interesting discovery by Mr. Nathan Banks of the common Phalangid of Wyandotte Cave, *Scotolemon flavescens* Cope, "under stones on the Virginia shore of the Potomac near Washington, D. C.," which, he says, "does not differ from cave specimens."[2]

A blind Salamander has also been discovered in this country by Mr. Stejneger. In the Rock House Cave, Missouri, on the walls, about 600 feet from the entrance, occurred a blind salamander (*Typhlotriton spelaeus*), forming a new genus and species of the family Desmognathidae. In the single adult captured the eyes are said to be "concealed under the continuous skin of the head." A larva was found, but, strangely enough, the condition of the eyes in the young is not referred to.

Passing out of our territory into Mexico, Professor Alfonso L. Herrera describes the results of his researches on the fauna of Cacahuamilpa Grotto, in Mexico. The new or more interesting forms are the following:

---

[2] The Phalangida Mecostethi of the United States. Trans. Amer. Ent. Soc., XX, 149-152. June, 1893.

INSECTS.

Choleva cacahuamilpensis (Ch. spelaea Bilmk.).
Tachys cacahuamilpensis (Bembidium unistriatum Bilmk.).
Ornix cacahuamilpensis (Ornix impressipenella Bilmk.).
Pholeomyia cacahuamilpensis Herrera.
Phalangopsis cacahuamilpensis Herrera (Ph. annulata Bilmk.).
Lepisma cacahuamilpensis Herrera (L. anophthalma Bilmk.).

ARACHNIDA.

Phrynus cacahuamilpensis Herrera (Ph. mexicanus Bilmk.).
Drassus cacahuamilpensis Herrera (D. pallidipalpis Bilmk.).
Nesticus cacahuamilpensis Herrera (Pholcus cordatus Bilmk.).

MYRIOPODA.

Scutigera cacahuamilpensis Herrera.

CRUSTACEA.

Armadillo cacahuamilpensis Bilmk.

I have received from Professor Herrera an eyeless Asellid crustacean taken from a well at Montery, Leon, Mexico. It shows no traces of eyes, and apparently belongs to a new genus, the species also being undescribed.

II. NEW FACTS REGARDING BLIND, NON-CAVERNICOLOUS, OR LUCIFUGOUS FORMS.

Although not a cave-dweller, the blind goby of the Californian coast lives in similar conditions and tells the same story as the blind Proteus of the cave of Adelsberg or the blind salamander of the Missouri Cave, of the loss of eyesight by disease. The blind goby (*Typhlogobius californiensis* Steindachner) occurs abundantly at Point Loma, San Diego, under rocks between tide-marks in holes made by "crabs" (more properly, shrimps). As Professor C. H. Eigenmann tells us, in his paper on the "Fishes of San Diego:" "It has been found nowhere else about San Diego, but has been taken at Ensenada. Its

habitat is, as far as known, quite limited. In its pink color and general appearance it much resembles the blind fishes inhabiting the caves of southern Indiana. Its peculiarities are doubtless due to its habits. The entire bay region is inhabited by a carideoid crustacean which burrows in the mud. It, like the blind fish, is pink in color. Its holes in the bay are frequented by Cleavelandia, etc., while at the base of Point Loma, where the waves sometimes dash with great force, the blind fish is its associate. . . . . In the bay the gobies habitually live out of the holes, into which they descend only when they are frightened, while at Point Loma this species never leaves its subterranean abode, and to this fact we must attribute its present condition.

" How long these fishes have lived after their present fashion it would be hard to conjecture. The period which would produce such decided structural changes can not be a brief one. The scales have entirely disappeared, the color has been reduced, the spinous dorsal has been greatly reduced; not only have the eyes become stunted, but the whole frontal region of the skull, and the optic nerves have been profoundly changed.

" The skin, and especially that of the head, has become highly sensitized. The skin of the snout is variously folded and puckered and well-supplied with nerves; the nares are situated at the end of a fleshy protuberance which projects well forward, just over the mouth. At the chin are various short tentacles, and a row of papillae, which very probably bear sensory hairs similar to those represented in Figs. 15 and 16 (Plate XXIII), extends along each ramus of the lower jaw, and along the margin of the lower limb of the preopercle. The eye is, however, the part most seriously affected. In the young, Fig. 7, it is quite evident, and is apparently functional. Objects thrust in front of them are always perceived, but the field of vision is quite limited. With age, the skin over the eye thickens, and the eyes are scarcely evident externally. As far as I could determine, they do not see at this time, and certainly detect their food chiefly, if not altogether, by the sense of touch. A hungry individual will swim over meats, fish or a mussel, etc., intended for its food without perceiving it by

sight or smell, but as soon as the food comes in contact with any portion of the skin, especially of the head region, the sluggish movements are instantly transformed, and a stroke of the fins brings the mouth immediately in position for operations."

Here, again, it may be observed that this blind fish is probably not older than the beginning of the Plistocene period, since we know that the coast of California has been rising since the Pliocene epoch, and therefore the coast lines have materially changed since the end of the Tertiary.

For a very full and elaborate account of the degenerate eyes of this blind fish we are indebted to Mr. W. E. Ritter, in an essay published during the present year. Besides the eyes he treats histologically of the integumentary sense papillae, and of the integument of this animal, giving a summary of his results on pp. 96 and 97, which we in part reproduce.

1. In the smallest examples of the blind goby studied, the eyes, though very small, are distinctly visible even in preserved specimens, the lens being plainly seen. In the largest specimens, on the other hand, they are so deeply buried in the tissue as to appear even in the living animals as mere black specks, while in preserved ones they are, in many cases, wholly invisible.

2. As is the case with rudimentary organs in general, the eye is subject to great individual variation in size, form, and degree of differentiation.

3. The only parts of the normal teleostean eye of which no traces have been found are the *argentea*, the *lamina suprachoroidea*, the *processus falciformis*, the cones of the retina, the vitreous body proper, the lens capsule, and, in one specimen, the lens itself.

4. In the parts present the rudimentary condition of the organ is seen in the very slight development of the choroid; in the fact that the choroid gland is composed entirely of pigment; in the fact that the iris, though of fully the normal thickness, is almost entirely composed of pigment; with great proportional thickness of the pigment layer of the retina and the entire absence in it of anything excepting pigment; in the minute size of the optic nerve, and finally in the small size of the *motores oculi*.

5. The surest evidences of actual degeneration are found, first, in the greatly increased quantity of pigment, and secondly, in the presence of pigment in regions where none is found in the normal eye, as in the hyaloid membrane.

6. On comparing the eyes of all blind vertebrates that have been most carefully studied, all may, in a general way, be said to be passing along the same degenerative path.

7. The eyes of blind vertebrates furnish very little evidence on the question whether structures in undergoing actual degeneration in ontogeny follow the reverse order of their phylogeny.

Ritter also states that from the works of European authors it is possible to make a detailed comparison of the eyes of Typhlogobius with those of *Proteus anguinus* and of the European mole, which he proceeds to do. On the whole, the eye of Proteus is more rudimentary than that of either Typhlogobius or Talpa, the lens being absent in the cave Amphibians. All authors, except Semper, are agreed that the optic nerve is present in both Proteus and Talpa, but Ritter finds no account of it ever having, in either of these animals, a pigment-sheath in its passage through the retina, such as occurs in Typhlogobius.

III. EMBRYOLOGICAL OBSERVATIONS ON THE CONDITION OF THE EYES IN THE EMBRYO OR IN THE YOUNG, PROVING THE ORIGIN OF THE BLIND OR EYELESS FORMS FROM NORMALLY-EYED ANCESTORS.

No complete observations have, so far as we are aware, been made on the embryology of cave animals, nor on that of eyeless non-cavernicolous forms, except in the few cases which we proceed to mention. In our essay on the Cave Fauna of North America (p. 139), we record the fact that in the young of the blind crayfish (*Orconectes pellucidus*), the eyes of the young are perceptibly larger in proportion to the rest of the body than in the adult, the young specimen observed being about half an inch in length. Previously to this, Dr. Tellkampf, in 1844, remarked that "the eyes are rudimentary in the adults, but are larger in the young." Mr. S. Garman

states, regarding the blind Cambarus of the Missouri Cave: "Very young specimens of *C. setosus* correspond better with the adults of *C. bartonii;* their eyes are more prominent in these stages, and appear to lack but the pigment." In the blind cave-shrimp (Troglocaris) of Austria, Dr. Joseph discovered that the embryo is provided in the egg with eyes.

In this connection should be recalled the observations of Semper in his Animal Life (p. 80, 81) on *Pinnotheres holothuriae*, which lives in the "water-lungs" of Holothurians, where, of course, there is an absence of light. The zoëa of this form has large, "well-developed eyes of the typical character. Even when they enter the animal, they still preserve these eyes; but as they grow they gradually become blind or half-blind, the brow grows forward over the eyes, and finally covers them so completely that, in the oldest individuals, not the slightest trace of them, or of the pigment, is to be seen through the thick skin, while, at the same time, the eyes seem to undergo a more or less extensive retrogressive metamorphosis."

In this connection may be mentioned the case of the burrowing blind shrimp (*Callianassa stimpsonii*) which has been found by Professor H. C. Bumpus, at Wood's Holl, Mass., living in holes at a depth of between one and two feet. He has kindly given me a specimen of the shrimp, which is blind, with reduced eyes, smaller in proportion to the body than those of the blind crayfish. He has also obtained the eggs, and has found that the embryos are provided with distinct, black, pigmented eyes, which can be seen through the egg-shell.

Recently, Zeller has studied the embryology of the Proteus of Adelsberg Cave, and has confirmed the statement of Michahelles, who, in 1831, discovered that the eyes of this animal are more distinct in the young and somewhat larger than in the adult. We quote and translate from Zeller's acccount:

"The development of the eyes is very remarkable; they are immediately perceived and present themselves as small, but entirely black and clearly drawn circular points with a slit which is very narrow and yet, at the same time, well-defined, and which penetrates from the lower circumference out to the middle.

"Indeed, one can hardly doubt that this astonishing development of the eye has been accomplished by the influence of light as has also the pigmentation of the skin, the reddish-white ground color of which appears thickly studded with very small brownish-gray points mixed with detached white ones, over the upper surface of the head and over the back down over the sides of the yellowish abdomen. Even on the edge of the fins (Flossensaum) the pigment is found. On the other hand there is a whitish spot over the snout as is likewise the case in the adult creatures which have been colored by the light. Both the under surface of the head and the entire abdomen are shown free from pigment like the limbs. . . . .

"I cannot specify very exactly as to when the pigmentation of the skin begins, but, in any case, it is very early and often earlier that the first beginning of the eyes can be discovered. The latter occurs toward the end of the twelfth week, at which time a thin, light gray line, which still appears overgrown, may be perceived, forming a half circle open underneath. Then while this line subsequently becomes clearer and darker and its ends grow further under and towards each other, there also takes place simultaneously a progression of the pigment larger towards the middle point, and the circle finally seems closed and filled up to the narrow slit mentioned above, which proceeds from the lower circumference and penetrates to the middle of the eye." (p. 570, 571.)

But the most striking discovery bearing on this subject is that of the condition of the eyes in the embryo and young compared with the adult of the blind goby of San Diego.

In his essay on the Fishes of San Diego, Professor Eigenmann briefly refers to and gives four figures (Pl. XXIV) of the embryo of Typhlogobius, Mr. C. L. Bragg having been fortunate enough to discover the egg in the summer of 1891. "The eyes develop normally, and those of Fig. 4 differ in no way from the eyes of other fish embryos." In this case, then, we have the simplest and clearest possible proof of the descent of this blind fish from individuals with eyes as perfect as those of its congeners.

We have been permitted by the Director of the United States National Museum to reproduce Professor Eigenmann's

excellent figures on the embryo, which tell the story of degeneration of the eye from simple disease of the organ, the species being exposed to conditions of life strikingly different from those of its family living in the same bay.

Before the discovery of the eggs, the youngest individual ever seen is represented in Pl. XXIII, fig. 7, its eyes being though small, yet distinct, and "apparently functional."

From these data it is obvious that future embryological study on cave animals will farther demonstrate their origin from ancestors with normal eyes.

IV. THEORETICAL RESULTS BEARING ON THE THEORY OF DESCENT, AND MORE ESPECIALLY ON THE NEOLAMARCKIAN PHASE OF THE THEORY, INCLUDING THE DOCTRINE OF THE TRANSMISSION OF ACQUIRED CHARACTERS.

It is evident that the cases just cited afford the strongest possible proof of the theory of evolution in general, and do not militate against the truth of the Neolamarckian phase of the theory, which holds that by a change of environment, inducing disuse of the eyes, such variations, especially atrophy of a part or whole of the eyes and optic nerves and ganglia have become established, so as to result in the origin of new species and even new genera.

In the case of the blind goby, the burrowing Callianassa, the blind shrimp of Adelsberg Cave, and, in fact, nearly, if not quite all the blind forms now known, it is easy to see that the causes of variation are quite direct and appreciable, and that we do not need to invoke the principle of natural selection. And this is the view of Darwin himself.[3]

Besides the factors of change of environment and of disuse, the influence of the isolation of these forms from their out-of-doors' allies should not be overlooked. Take the case of the blind goby of San Diego Bay, or the Callianassa of Buzzard's Bay. Living in habitats remote from their congeners, obvi-

---

[3] In our work on the Cave Fauna of North America we have discussed the bearing of the facts of cave-life on the Darwinian and Lamarckian phases of evolution and have attempted to show that natural selection is inoperative in such cases as these, quoting Darwin's own words when referring to the loss of eyes in such animals: "I attribute their loss wholly to disuse." (p. 137–143).

ously as soon as their ancestors took up a burrowing mode of life, they were prevented from crossing with others of their species, and, probably, when in sporadic cases it did occur, very soon the swamping effects of intercrossing wholly ceased, only those in which the eyes had begun to degenerate interbreeding. After a few generations, therefore, owing to this isolation, the partially blind forms became fixed by heredity and by the very force of circumstances a blind or eyeless generation resulted.

These circumstances are paralled by the results of the intermarriage of deaf-mutes. Professor A. Graham Bell[4] has pointed out the danger of the establishment of a distinct variety of deaf-mutes with a special sign language of their own, since owing to their peculiar social environment and isolation in society there has lately arisen a strong tendency of deaf mutes to intermarry. The result, so far as gathered from a tolerably wide range of facts, shows that this incipient deaf mute strain or variety may have originated in two generations, since it seems probable, as Mr. Bell remarks, " that the oldest deaf mute in the country whose parents were both deaf mutes is now only a little past middle age."

Moreover, the cases we have cited tend to show that the origination of new species and genera of subterranean, as well as deep sea forms and others living in darkness, may have been induced after comparatively few generations. Future observations should be directed to this point. The moment that several individuals became isolated in dark holes or in caves, and more or less confined in such narrow limits, the effects of darkness would at once begin to be experienced, and some degree of adaptation to their changed conditions would immediately begin to operate. The individuals of this generation, i, e., the new comers in the cave, or those gobies which by burrowing in the mud had penetrated out of reach of their

---

[4] On the formation of a deaf variety of the human race. Memoirs National Academy of Sciences for 1883, Washington, ii, 179–262, 1884. The author points out the means of isolation of deaf mutes through asylums and national, state and city associations for promoting social intercourse, often resulting in intermarriages. He also gives "specimen cases to prove that in many different parts of the country deafness has been transmitted by heredity." (p. 210).

congeners, would doubtless become used to life in darkness. Their offspring of the first generation might or might not suffer some alteration in the visual organs, but doubtless some slight degree of physiological change would result; this might or might not be latent in the next generation, or it might crop out and become manifested in the first generation, or, if not in the first, in the second or third. As soon as the degeneration in the eye-sight began to become fixed by heredity, the process must have gone on rapidly, and, in a few generations, perhaps a dozen or twenty, or fifty, rather than many hundreds or thousands, or "numberless generations," as most writers since Darwin claim.

Now as deaf mutes already appear to breed true to their incipient strain or variety, whether congenitally deaf or rendered so by disease during the lifetime of either or both parents, it seems most probable that animals not at first congenitally blind, might have acquired, after having been carried into, and after living for some months or even years in darkness, the tendency to blindness, and have transmitted to their offspring such first steps in adaptation to their Cimmerian environment. It is difficult for any one, it seems to us, not hidebound by theory to imagine any other mode of procedure.

The steps in the process are these: 1, The change in environment from normal conditions to partial or total darkness; 2, At first a slight degree of adaptation to such change, if the animal survived at all; 3, Becoming gradually habituated to the darkness, compensation for the loss of eyesight would result in the stimulation of the senses of touch and smell; 4, Meanwhile the physiological change from loss of eyesight would react on the physical structure and the eye would begin to degenerate, and very rapidly, after a few generations, the optic nerves in some forms, or the optic lobes and nerves in others, would disappear, the vestiges of the outer structures of the eyes remaining in some forms long after the nervous connections between the eyes and the brain had become effaced; 5, Meanwhile, segregation would prevent intercrossing with newcomers provided with perfect eyes, and consequently would prevent the swamping of the new characters resulting from

disuse; 6, The new variety or species or genus, as the case might be, would become persistent, as long as the conditions of total or partial darkness continued.

Now these factors, so simple, so easily appreciated, that as early as 1802, Lamarck could see their force, though he only cited the case of the mole, for he knew nothing of cave animals—these factors would seem to be adequate for the production of these eyeless forms. These results of disuse seemed adequate to Darwin himself, the founder of the doctrine of natural selection; and yet the extreme Darwinians or Neodarwinians of the present day push aside or are purblind to these fundamental factors of organic evolution, and insist that the *vera causa* of the evolution of these blind forms is either natural selection or panmixia, and they likewise deny that there is any ground for the operation of the principle of transmission of acquired characters.

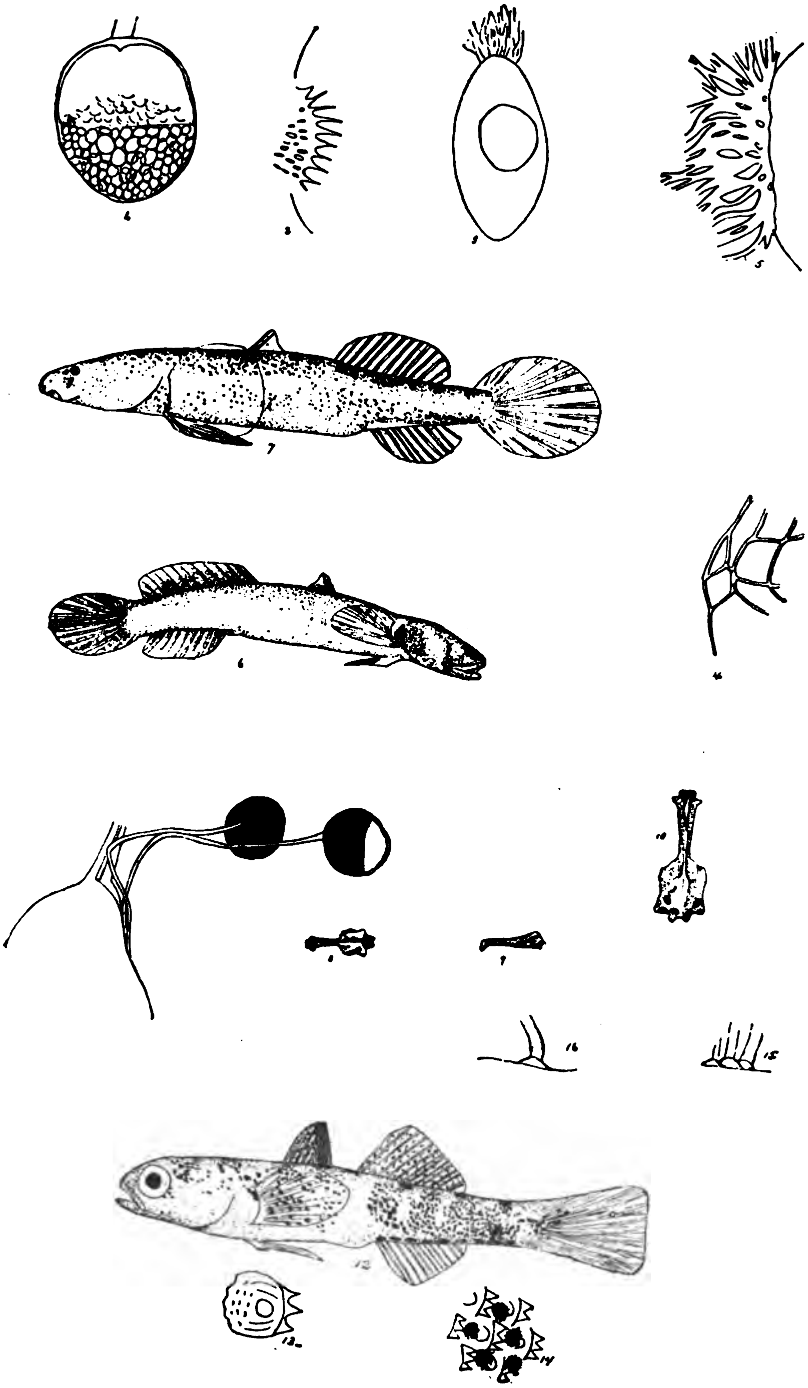
Weismann, who has rendered such eminent service to biology, in establishing the principle of heredity on a physical basis, as is well-known, pushes aside all these factors and explains the blindness of cave animals by a negative cause, "panmixia," i. e., the absence of natural selection. In his "Essays on Heredity" (1889) he claims that the small eyes of moles and of other subterranean mammals can be explained by natural selection, and remarks: "I think it is difficult to reconcile the facts of the case with the ordinary theory that the eyes of these animals have simply degenerated through disuse" (p. 86). He assumes that the degeneration of the eye of Proteus "is merely due to the cessation of the conserving influence of natural selection," and, he adds farther on, "this suspension of the preserving influence of natural selection may be termed Panmixia." And he even goes so far as to express the opinion that "that the greater number of those variations which are usually attributed to the direct influence of external conditions of life, are to be attributed to panmixia." He thus substitutes for the positive, tangible factors of change of environment, disuse and isolation, the negative and hypothetical one which he calls "panmixia."

In his discussion on this subject, as well as those of others who have adopted his views, Weismann, and his English translators, do not always give evidence of having carefully read the statements of those who have paid some practical attention to cave animals, Weismann only referring to the cases of the mole and of the Proteus. For instance, he remarks, "If disuse were able to bring about the complete atrophy of an organ, it follows that every trace of it would be effaced (pp. 90 and 292). Now in our "Cave Fauna of North America," published two years before the issue of the English translation of Weismann's essays, we have shown from microscopic sections that in the different species of blind beetles (Anopthalmus) not only is every trace of the optic ganglia and of optic nerves wanting, but also every trace of the eyes themselves. Also in the blind myriopods of Mammoth Cave, *Scoterpes copei*, no traces of the optic ganglia, optic nerves, or of any part of the eyes, including the pigment of the retina or the corneal lenses, were to be discovered. While in the blind crayfish the degenerate eyes are retained, in some individuals of an Asellid (*Caecidotaea stygia*), the eyes may be entirely effaced as well as the optic ganglia and optic nerves. On p. 118 of the memoir referred to there is a summary view of the effects upon the eyes, optic ganglia, and optic nerves, of different Arthropods resulting from living in total darkness.

Again, on p. 87, Weismann makes the following somewhat loose statement: "blind animals always possess very strongly developed organs of touch, hearing and smell." We have laid special emphasis in our essay on compensation by the development of tactile and other organs for the loss of eyesight or of eyes in cave animals, and while Weismann's assertion is true as regards the tactile and olfactory senses, it is curious that, from the direct and repeated observations of Dr. Sloan, which we quote, the blind fish occurring in Wyandotte Cave is, contrary to Wyman's and to Cope's suppositions, not sensitive to sounds.

The blind crayfish of Mammoth Cave, and also the species (*Orconectes hamulatus*) of Nickajack Cave, have, as we have ascertained by anatomical investigation, degenerate ears, so

PLATE XXIII.



Typhlogobius, Etc.

that the sense of hearing is, with little doubt, nearly, if not quite, obsolete (p. 128).

While, then, Weismann claims that there is a cessation of natural selection in the case of cave animals, another writer, Lankester, in a brief note in *Nature*, asserts that the blindness of cave animals is due to natural selection, remarking: "This instance can be fully explained by natural selection acting on congenital fortuitous variations. Many animals are thus born with distorted or defective eyes, whose parents have not had their eyes submitted to any peculiar conditions. Supposing a number of some species of Arthropod or fish to be swept into a cavern or to be carried from less or greater depths in the sea, those individuals with perfect eyes would follow the glimmer of light and eventually escape to the outer air or to the shallower depths, leaving behind those with imperfect eyes to breed in the dark place. A natural selection would thus be effected. In every succeeding generation (bred in the dark place) this would be the case, and even those with weak but still seeing eyes would, in the course of time, escape, until only a pure race of eyeless or blind animals would be left in the cavern or deep sea."

This explanation seems, however, vague and speculative, as well as inadequate, when we compare the kind of natural selection here invoked with such direct, powerful and readily appreciated factors as partial or total darkness (no plants being able to grow in caves, and only a very scanty fauna); added to the disease of organs whose very existence was originally due to the stimulus of light, and where, were it not for their enforced isolation, the swamping effects of crossing with eyed forms would constantly tend to prevent the permanent existence of blind or eyeless forms. Besides, how can the variations be fortuitous when the overshadowing and all-prevailing influence is darkness, this cause inducing a change primarily in a single organ, and, in a single sense, due to a single cause, urging the variation in a determinate way? Indeed, it may be questioned whether variations are ever "fortuitous" in the sense that they can arise independently of and are not controlled by the ever active forces of nature.

It is apparent that both of the last named writers, who have not themselves had a practical experience in collecting and studying cave animals and their surroundings, nor have carefully read the recent literature on the subject, are overmastered by speculative views, and prefer to make an extremely vague, unscientific and *a priori* speculation, rather than adopt an opinion based on the inductive method.

In refreshing contrast are the views of the veteran English philosopher, Mr. Herbert Spencer, who, like Darwin, fully appreciates the direct bearings of disuse as a fundamental factor, and, with his rare good sense and penetration, recognizes the probability of the active agency of the principle of the transmission of acquired characters in the origin of cave life.

Indeed, in caves, deep holes or burrows, or in dark subterranean streams and wells, to which the blind are restricted, we have conditions very closely parallel to those which obtain in asylums for the deaf and dumb. The array of facts presented by Professor A. Graham Bell and the danger which exists of the formation of a distinct deaf-mute variety of mankind, and the suggestions which he offers as to the most practicable way to arrest the further development of the incipient variety, all afford an interesting and striking parallel to the case of blind animals which are to be found living in caves and similar places.

The cave fauna, as a whole, is composed of individuals, all existing under the same conditions, living in partial or total darkness, and with eyes either defective or absent. Now, how did they come there? We occasionally find, all over the world, creatures with defective sight or imperfectly-developed eyes, but such cases are sporadic, and are not numerous enough in proportion to the normal population to breed together and to multiply. Where, however, individuals with more or less defective eyes should breed with normal mates, any tendency to the transmission of such defects would be wiped out by the swamping effects of crossing, owing to the immense preponderance of normal, vigorous forms with perfect vision. The whole tendency in nature in the upper world of light is to weed out such sporadic, defective forms. But in limestone

regions honeycombed with caves and permeated with subterranean streams, like those in the Mediterranean regions, France, Spain, and Austria, or in those of southern Indiana, Virginia, Kentucky and Missouri—in such regions as these, there exist the conditions favorable to the origination and perpetuity of blind forms. To give an example, eyed geodephagous beetles, such as the species of Trechus, of which there are so many in southern Europe, accustomed to burrowing in the soil under stones, when carried down by various accidents into dark crevices or into caves from which they are unable to extricate themselves, and too hardy and vigorous to succumb to the deadly effects of a life in perpetual darkness, and with, perhaps, already partially lucifugous habits, such forms under these changed conditions survive, breed and multiply, finding just enough food to enable them to make a bare livelihood, and with just enough vigor to propagate their kind. We can easily imagine that in time, and indeed no very long period, the newcomers would soon become adapted to their new surroundings, an environment abnormal both from the absence of light, and from the lack of predaceous forms to devour them; and they would live on, weak, half fed, half blind, forced to make their asylum in such forbidding quarters.

Where are there, in such circumstances as these, any of the conditions which would imply that any struggle for existence or processes of natural or sexual selection in these trogloditic societies are possible? On the contrary, it seems to us that in such unwonted conditions as these, darkness, lack of suitable food, and lack of destructive, carnivorous forms, other than the blind species themselves, we are brought face to face with the more powerful, primary, purely physical agents, which have produced changes chiefly operating in a single direction, i. e., to destroy the vision and to more or less completely abolish the eyes. Here we see exemplified in a typical way the direct action of the Lamarckian factors, viz.: Change of surroundings, coupled with disuse of parts useless in such altered conditions, and then the enforced isolation, especially marked in the cases of the Proteus and of the blind crayfish, etc., which never occur out of caves, however it may be with those species

living in dark wells or subterranean streams, which have a more or less direct connection with the upper world.

As regards the problem of the transmission of acquired characters, it would appear that the case with cave animals is paralled by that of deaf mutes collected together in asylums, and united by various social organizations. It has been shown in a striking way by Mr. Turner, as quoted by Bell, that "before the deaf and dumb were educated, comparatively few of them married." Bell concludes, from an examination of the records of deaf mute asylums in the United States, "that of the deaf mutes who marry at the present time, not less than 80 per cent marry deaf mutes, while of those who married during the early half of the present century the proportion who married deaf mutes was much smaller."

It was also clearly indicated that "a hereditary tendency towards deafness, as indicated by the possession of deaf relatives, is a most important element in determining the production of deaf offspring," and "it may even be a more important element than the mere fact of congenital deafness in one or both of the parents."

It appears, then, that it is the segregation of deaf mutes, inincluding nearly half of the deaf mutes who became deaf from accidental causes, which has led to the apparent increase of this incipient strain or breed of human beings. And the statistics and conclusions given by Mr. Bell appear to almost demonstrate the fact of the transmission of characters acquired during the lifetime of the individual, and that it is difficult to draw the line between this phenomenon and the transmission of congenital characters; the latter being, at present, the more frequent and therefore normal law of heredity, though it was not so in the beginning. For, as Bell, after a careful study of statistics, remarks, "The numbers of the non-congenitally deaf are evidently subject to great and sudden fluctuations on account of the epidemical diseases which cause deafness, whereas, the growth of the congenitally-deaf population seems to be much more regular."

Premising that heredity does not, at the best, always unerringly act, that its results are sometimes uncertain, even where

those with congenital variations breed together or intermarry, it is also to be taken for granted that it may, at times, be impossible to draw the line between the transmission of congenital and of acquired characters.

When a number, few or many, of normal, seeing animals enter a totally dark cave or stream, some may become blind sooner than others; in others there may be developed only a tendency to blindness, the eye itself being imperceptibly modified by disuse, while a certain percentage may possess the tendency plus a slight physical defect, either functional or organic, in the eyes, especially in the optic nerves and ganglia. The result of the union of such individuals and of adaptation to their stygian life would be broods of young, some with vision unimpaired, others with a tendency to blindness, while in others there would be noticed the first steps in degeneration of nervous power and of nervous tissue. Even in a succeeding brood, or in a third brood, we might have a few individuals which were born blind or partly so, and were compelled to feel their way about the cave, while the far more numerous members of the colony would only exhibit a tendency to the disuse of their eyes, attempting to see their way rather than to feel it. Thus, after a few, or only several generations, the society of troglodytes, vertebrate and invertebrate, might be compared to a newly-established asylum of deaf mutes or to an asylum for the blind, if they interbred in the same proportions.

At first, then, the number of cases of those not congenitally blind, but which, after living for most of their life time in darkness and becoming so modified that they could dispense with the use of their eyes, *pari passu* becoming more and more dependent on the exercise of their tactile organs—at first, such individuals as these would greatly preponderate.

So all the while the process of adaptation going on, the antennae and other tactile organs increasing in length and in the delicacy of structure of their olfactory and tactile structures, while the eyes were meanwhile diminishing in strength of vision and their nervous force giving out; after a few generations, (perhaps, judging by what we know of the sudden production of deaf mutes in human societies, only two or

three,) the number of congenitally blind would increase, and, eventually, they would, in their turn, preponderate in numbers.

It is also possible that the longevity of cave animals, owing to the absence of ordinary enemies and of casualties, such as occur in the upper world, even though the supply of food were greatly restricted, would be much greater than in epigaean regions. If this be so, then there is a more favorable opportunity for the development and fixation of the myopic condition in subterranean situations.

It thus appears that while the heredity of acquired characters was, in the beginning, the general rule, as soon as the congenitally blind preponderated, the heredity of congenital characters became the normal state of things, the inhabitants being all blind, and for generations breeding true to their specific and generic characters.

On the other hand if the conditions should be changed, and the cave become opened to the light, then we should expect a gradual reversion to their eyed ancestors. This process would, of course, be due to causes exactly opposite to those producing the blind form, i. e., the presence of light, etc. In such a case, neither natural selection nor panmixia would be the factors, although some one might give a high-sounding, "scientific" name to the supposed process. And this shows how inoperative can be natural selection or panmixia as true working causes of the transformation of species, compared with the operation of the fundamental factors of organic evolution postulated by the Neolamarckian.

LIST OF ESSAYS AND ARTICLES RELATING TO BLIND OR CAVE ANIMALS PUBLISHED SINCE 1887.[5]

A. *The general subject, including anatomical, physiological, and theoretical considerations.*

Ciaccio, G. V. Osservazoni intorno alla membrana del Descemet e al suo endotelio con una descrizione anatomica dell'

---

[5] This list is supplementary to that published in my essay on the Cave Fauna of North America Memoirs of the National Academy of Sciences, 1889, and includes some titles omitted in that bibliography, many of which are copied from Ritter's work.

occhio della Talpa europea. Mem. Acad. Sci. Instituto di Bologna. Ser. 3, Tom. v, p. 501, 1875.

Edwards, W. F. De l' influence des agents physiques sur la vie (pp. 12 et 41–62). Paris, 1824.

Hermann, L. Handbuch der Physiologie. Bd. iv, ii, 1882.

Hertwig, O. Lehrbuch der Entwicklungsgeschichte des Menschen und der Wirbelthiere. Jena, 1890.

Hess, C. Beschreibung des Auges von Talpa europæa und Proteus auguinus. Archiv. für Ophthalmologie, Bd. xxxv, p. 1, 1889.

Hoffman, C. K. Zur Ontogenie der Knochenfische. Archiv für Mikro-Anat., Bd. xxiii, p. 45, 1883.

Kadyi, K. H. Ueber das Auge der Maulwurfs (*Talpa europæa*) in vergleichend-anatomischer Hinsicht (Polisch.) Denkschr. Akad. d. Wissens. Krakau, Math.-Naturhist. Abtheil. Bd. iv, p. 124, 1878.

Kessler, Leonhard. Zur Entwickelung des Auges der Wirbelthiere. Leipzig, 1877.

Kohl, C. Einige Notizen über des Auge von Talpa europæa und Proteus anguinus. Zool. Anzeiger. Bd. xii, pp. 383, 405; 1889.

Krause, W. Die Retina, II. Die Retina der Fische. Internat. Monatschr. für Anat. u. Histol., Bd. III, p. 8, 1886.

Michahelles. Oken's Isis, 1831, p. 501 (Eyes in young more distinct and somewhat larger than in the adult) (Vide Boulenger).

Müller, Johannes. Vergleichende Anatomie der Myxinoiden. Abhandl. Akad. Wissensch. zu Berlin, 1834.

Parker, S. H. The eyes in blind crayfishes. Bull. Mus. Comp. Zool. Harvard University, XX, No. 5., pp. 153–162, 1890.

Schampp, K. W. Die Augenlinse des *Proteus auguinus.* Biol. Centralblatt. Bd. XI, No. 2, p. 40, 1891.

——— Das Auge des Grottenolmes (*Proteus auguinus*). Zeitschr. für Wissen. Zool., Bd. LIII, p. 537, 1892.

Spencer, Herbert. Inadequacy of Natural Selection. 1893.

Wallace, Alfred Russel. Darwinism. 1889.

Zeller, Ernst. Ueber die Larve des Proteus anguineus. Zool. Anzeiger, No. 290, XI, Jahrgang, 8 Oct., 1888, pp. 570–572, and Jahresh. Ver. Naturk. Württ., xlv, 1889, p. 131 (colored plate of the larva).

Zuntz, W. Handbuch der Physiologie (Hermann). Bd. IV, Th. 2, p. 144, 1882.

B. American Cave Animals.

Cope, Edward Drinker. On a Blind Silurid from Pennsylvania. Proc. Acad. Nat. Sci. Phila., Vol. XVI, p. 231. 1864.

Eigenmann, Carl H. The Point Loma Blind Fish and its Relations. Zoë., Vol. I, p. 65, 1890.

——— The Fishes of San Diego. Proc. U. S. Nat. Mus. XV, pp. 123–178, 1892.

Smith, Rosa. Note on Typhlogobius Californiensis. Zoë. Vol. I, p. 181, 1890.

Garman, H. The Origin of the Cave Fauna of Kentucky, with a description of a new Blind Beetle. Science.

Garman, S. Cave Animals from Southwestern Missouri. Bull. Mus. Comp. Zool., p. 240, Oct. 28, 1892. No. 6, p. 225–240. Cambridge, Dec., 1889.

Girard, Charles. Ichthyological Notices [XIII], Proc. Acad. Nat. Sci. Phila., Vol. XI, p. 63, 1859.

Lockington, W. N. Walks around San Francisco. Amer. Nat., Vol. XII, p. 786, 1880.

Garman, H. On a Dipterous Larva from Mammoth Cave. Bulletin Essex Institute, xiii, 1891.

——— A Silk-Spinning Cave Larva. Science, xxii, No. 546, July 21, 1893, p. 33.

Smith, Rosa. Description of a new Gobioid Fish (*Othonops eos*) from San Diego, California. Proc. U. S. Nat. Mus., 1881. Vol. IV, p. 19; also Smithsonian Misc. Collections, Vol. XXII, p. 19.

Packard, Alpheus Spring. Notes on the epipharynx, and the epipharyngeal organs of taste in mandibulate insects. Psyche, Vol. V, April, 1889, p. 198–199. (Taste organs of *Hadenœcus subterraneus* from Mammoth Cave).

Stejneger, Leonhard. Preliminary description of a new genus and species of blind cave Salamander from North America. Proc. U. S. Nat. Mus., XV, pp. 115–117. No. 894. Washington, 1892.

C. Cave Animals in other Countries.

Bolivar. Annales Société Entomologique de France. 1892.

Chilton, C. On the subterranean crustacea of New Zealand, with remarks on the fauna of caves and wells. Linnean Society of London, 1893.

D. Theoretical Discussions.

Anderson, A. Blind Animals in Caves. Nature, March 9, 1893, p. 439.

Boulenger, G. A. Blind Animals in Caves. Nature, Apr. 27, 1893, p. 608.

Cunningham, J. T. Blind Animals in Caves. Nature, March, 9, 1893, p. 439; Apr. 6, 1893, p. 537.

Lankester, Edward Ray. Art. Zoology, Encyl. Brittanica and The Advancement of Science, 1890. Blind Animals in Caves. Nature, Feb. 23, 1893, p. 389.

Spencer, Herbert. The Inadequacy of Natural Selection. Contemporary Review, Feb., March and April, 1893.

Weismann, August. Essays upon Heredity. Oxford, 1889.

THE NUMERICAL INTENSITY OF FAUNAS.[1]

By L. P. Gratacap.

In the various aspects of the Development of Life upon the earth the attention of the student has been principally directed to the question of form, as a problem of derivation. The external configuration of the enclosing frame-work or envelopes of organisms, or the modified outlines of internal skeletons have been closely compared, and species have been defined upon their differences, and the record of the march of specific change, group segregation and class development compiled from their study. The enumeration of species as they multiply, or decrease and disappear has been made, and the successive expansions and contractions of the lineal avenues of descent extensively elaborated. The student has less frequently been brought to consider the question of number, the numerical increase of forms, or to attach any biological significance to the arithmetical rise or decrease of species. It is, upon a little reflection evident that the subject of numbers, if it admits of any determination, may have or must have, a direct connexion with the ease and spontaneity with which a new or old species maintains itself, and may prove an index of the severity of competition or of the difficulty of living in its field of zoological activity.

Assuming the rate of increase uniform, the apparatus and impulse to procreation identical in a number of species, that one, of course, will survive in the greatest numbers whose life is attended with the least friction, against whose functions and habits the smaller array of obstacles active and passive exist. The comparison of species in this respect, so far as it is used to make out the comparative adaptation of species to certain conditions, assumes of necessity an identical fecundity in each species, and the comparison has, therefore, valid probability between species of the same families, or genera or perhaps classes.

---

[1] Paper presented at Brooklyn Meeting of the Amer. Ass. Ad. Sci, Aug., 1894.

On the other hand a more recondite suggestion is made in this inquiry. Favorable conditions for the multiplication of a species, such as temperature, food-supply, freedom from enemies, habitability of station, etc., naturally assist numerical increase. But the speculation suggests differences in the time required for a species to attain *momentum*, the time required for it to reach the maximum rate of increase, when its vitality has attained such force as to most effectually overcome hampering conditions, and is recorded in the number of individuals produced at one period. This question touches the surmises made as to the manner of specific introductions. Does a species make its appearance in one example—as an individual—on the world's stage or, if diœcious, in pairs, and then proceed to establish its currency, and so in geometrical ratio of increase engage itself in subjugating its environment and dispersing or suppressing its competitors? Or do species appear in numbers, and from separated points of occupation begin spreading, until their divided areas coalesce, and their geographical coincides with their numerical maximum? Or finally does the manner of their entrance into life vary for different species, or the species of different groups in both these ways? It seems probable that the higher orders of animals—especially the vertebrates—are *sporadic* in their appearance, viz., differentiate as individuals, while the lower are *massive*, viz., differentiate in hosts.

Conditions being equal the invertebrates should reach their numerical maxima quicker than the higher vertebrates, and their maxima should, comparatively, reach enormously higher figures. What the functional activity of procreation in a new species is, cannot be determined. It would seem probable that if specific variation were a process of insensible or slightly sensible changes in forms or external physical features, the correlated disturbances of function would be imperceptible and the new species would carry on the work of self-propagation with the same energy as the allied species amongst whom it makes its appearance. The actual numerical results would be at first low, because of the smaller number of individuals of the new species and would increase as that number enlarged,

and the opportunities or occasions of procreation multiplied. Again it is necessary to consider a reversal of this. The sterility of the offspring of crossed parents of different species points to the fact that there are or may be functional changes in the powers of generation, and that the new species, is, by this law, made dependent for its successful extension, upon the intercourse of similar individuals. It is likely that in connection with the rise of a new species those organs concerned in reproduction have become modified, and the system of seminal secretion, which carries with it the power of perpetuating the new forms, has itself been more or less profoundly affected. From such considerations it seems fairly probable that new species appear in limited numbers, and acquire after time the full power of propagation until with increasing numbers the maximum of their numerical rise is reached, and then that decadence begins which ends in their disappearance. It will be understood that by "limited numbers" we mean such representations of species as are much below their later and more normal development.

It then appears from such considerations, without further detail, that the factors of numerical increase are two, the external or physical conditions of life, and the internal or biogenetic force of propagation. As regards the first, the external or physical conditions of life, it may be assumed that the appearance of a species must take place under favorable conditions, if we are to accept the Darwinian hypothesis, that specific origination means that very thing, the better adaptation of new species to reigning conditions than any other, for it is its preponderant aptitude for life under these conditions that brings the new species into existence. So that as regards the encouragement to increase given by the external conditions it is unexceptional or adequate, and the rate of multiplication is then made dependent upon the physiological factor, the power and provision for propagation. These favorable conditions will be temporary. They will be succeeded by others less favorable, and the species, started under way under the best external auspices will begin to work against physical detriments and brakes that will lower its vital momentum, and, unless

the biogenetic factor keeps up or even becomes intensified, the species begins its downward course, since numerical diminution means final extinction. The biogenetic factor, the influence of propagation, will, in all probability, decline with any changes in external conditions which affect the physical wellbeing of the organism, so that the sum of influences springing from external circumstances and internal conditions work conjointly to exhilerate or depress the life of the animal. Furthermore, although a new species responds more fittingly to its environment and possesses peculiar advantages over its companions, this species, it may be assumed, survives because it is less at odds with its surroundings, not because it is most appropriately placed. As it becomes more and more part of the new status which brought it into existence, its organism more and more nearly attains its limital fecundity.

The list of possible combinations of conditions upon the emergence of a species would then be four.

First.—Favorable Environment and High Vitality=procreative activity.

Second.—Unfavorable Environment and High Vitality.

Third.—Favorable Environment and Low Vitality.

Fourth.—Unfavorable Environment and Low Vitality.

The discussion of these four *as limital expressions*, covers the varying phases under which a species attains its numerical maximum. And this discussion assumes, for the sake of reaching definite results, that the species is considered as restrained by the boundaries of a limited area, an assumption not very much at variance with facts.

Favorable Environment and High Vitality.—In this case the species would rapidly rise to its numerical maximum, and maintain it as long as the environment and its own vitality remained propitious. But this very intensity of development would lead to the deterioration of the species, and bring about its own extinction. The competition between its own representatives would become exasperated through their great number, and this would drain the food-supply, while the excessive productivity would reduce procreative power. The zoological consequence, in this instance, would be quick

numerical expansion followed by a more or less abrupt decline. Darwin says (Origin of Species Chap. X, 1860). "There is reason to believe that the complete extinction of the species of a group is generally a slower process than their production; if the appearance and disappearance of a group of species be represented as before by a vertical line of varying thickness, the line is found to taper more gradually at its upper end, which marks the progress of extermination, than at its lower end, which marks the first appearance and increase in numbers of the species." In the case of favorable environment and high vitality the line would probably begin suddenly with a thickened end, continued and increased for some distance, and slope steeply to its termination. Two examples in paleontological history illustrate this; the Trilobitic fauna of the Upper Cambrian, the Potsdam of Wisconsin and Minnesota, and the successive Ammonitic faunas of the Jura-Lias in Europe.

Prof. Hall recognized and tentatively separated three horizons of the trilobitic beds of Wisconsin and Minnesota; the earlier trilobites were referable in numbers to the genus *Conocephalites* while *Dicelocephalus* emerges in the middle beds and becomes numerically important through these and the higher beds. Prof. Hall was struck with their extreme abundance, and records his own impressions in these words; "the multitude of individuals of a few species is really wonderful; for in some beds the layers may be separated at every inch, or even half inch, and yet the entire surface is covered with the dismembered parts of these ancient trilobites." As to the Ammonites of the Jurassic they are celebrated for the sharpness of lines of demarkation between beds abounding in great numbers of the different species.

Unfavorable Environment and High Vitality.—In this case there would result a variable numerical abundance according to the equilibrium established between these discordant factors, but the average result would be a numerical uniformity extended over a considerable length of time. The procreative power would replenish the losses by death, and keep up, at least at first, a uniform amplitude of life. The unfavorable environment would work a defeating influence upon procrea-

tion, and after a length of time, bring about a low vitality which in conjunction with the uncongenial surroundings would wind up the species.

Of course the term *unfavorable* is here used comparatively, not meaning *inimical*, because a new species upon the doctrine of adaptation could not arise in hostile circumstances, but meaning less favorable than the *most* auspicious surroundings. The result as measured in numerical estimates would be a low mean, which perhaps as the environment improved might increase. It is only likely that such conditions are present when a species migrates, or is invaded by a change of physical conditions less advantageous than those it has previously enjoyed. A new species with high vitality is hardly consistent with unfavorable environment at the beginning, and the category we are considering would only be exemplified in the numerical exhibit of species whose habitat has been affected unfavorably. The repression of great numbers of individuals at any one time would tend to lengthen the life of the species, inasmuch as it would relieve it from struggle in its own midst, and this would have a tendency to extend its days.

In the paleontological record the case of *Atrypa reticularis* seems to illustrate this numerical constancy. From the Upper Silurian in the Niagara through the Lower Helderberg, Oriskany Schoharie and Upper Helderberg it keeps up a more or less uniform though not excessive representation until diverging in the Devonian into *A. vexata* and *A. spinosa* it becomes itself more numerous seeming then to pass under the conditions of the first category—high vitality and favorable environment—and declining rapidly terminates in the Upper Hamilton. *Atrypa reticularis*, as is well known, does not attain a large size in the Silurian, but, according to Hall, exhibits considerable variety of form. It is in the stage of "*oscillation*," not yet having attained specific fixity and this fact of formal instability points to a lack of congruity between itself and its environment and leads us to consider it an example under this heading.

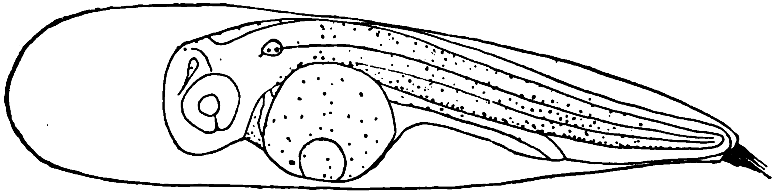
Favorable Environment and Low Vitality.—By "Low Vitality" we here designate a certain sluggishness in fecundity in cer-

tain animals though the value of the procreative energy considered at the instant of its exercise may be high. Evidently for such animals their duration in time will be conditioned largely upon favorable circumstances of life and without these they must undergo extinction. The numerical representation must always be small; it is essentially limited by their intrinsic predisposition to be slow breeders. This assumption seems applicable to species which without any apparent change in their environment become subject to a progressive failure in numbers. The history of invertebrate life on the earth's surface emphasizes this. Throughout similar conditions or what, from lithological evidence, seem *identical* conditions, species dwindle and disappear. On what hypothesis can this gradual vanishment be explained, except that the living momentum has run down, a physiological deterioration has set in, which must, no matter how auspicious be the physical requirements, compass the discomfiture and suppression of the species. Low vitality might also reasonably imply a certain functional weakness which affects the organic intregrity of a species. Under either implication, that of low procreative power or functional weakness, favorable environment fictitiously prolongs the life of the species and gives a deceptive appearance of stability to a species internally disintegrating. Its numerical ratio must be a reduced one.

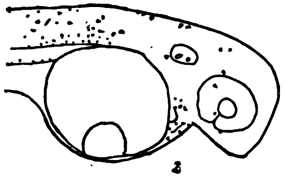
Unfavorable Environment and Low Vitality.—This category symbolizes the rapid decline of a species, and is symptomatic of the final stages in its life-history. Where unfavorable conditions combine with intrinsic decrepitude the doom of a species is quickly sealed, and it vanishes from the scene scarcely noticed amidst the on-coming armies of new and intense competitors.

These four categories which we have epitomized, embodying the relations of *vitality* to *environment* and applied to the phenomena of the numerical abundance of a species, may be generally regarded as the formal stages of a species' decline. And we observe that the succession of these stages may follow one of two directions as divergent lines from an original condition. That original condition is *Favorable Environment and*

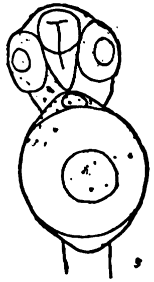
PLATE XXIV.



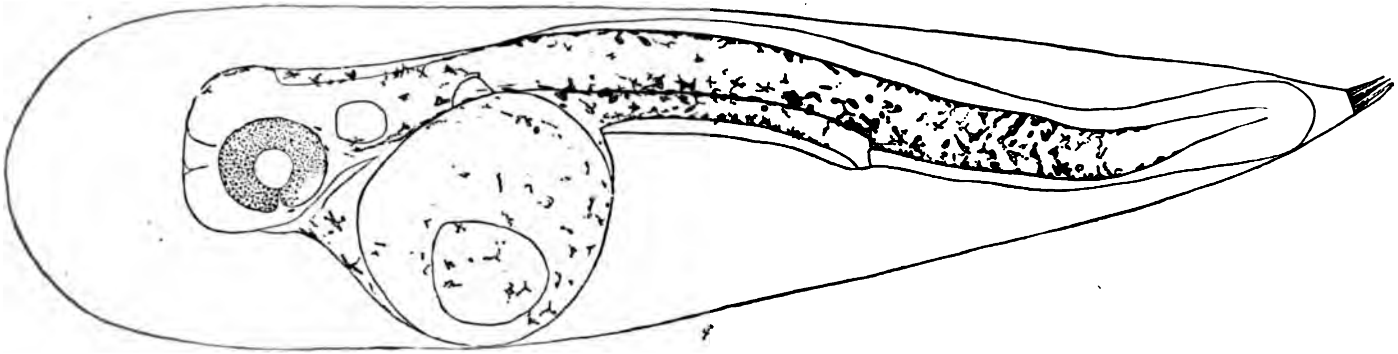
1



2



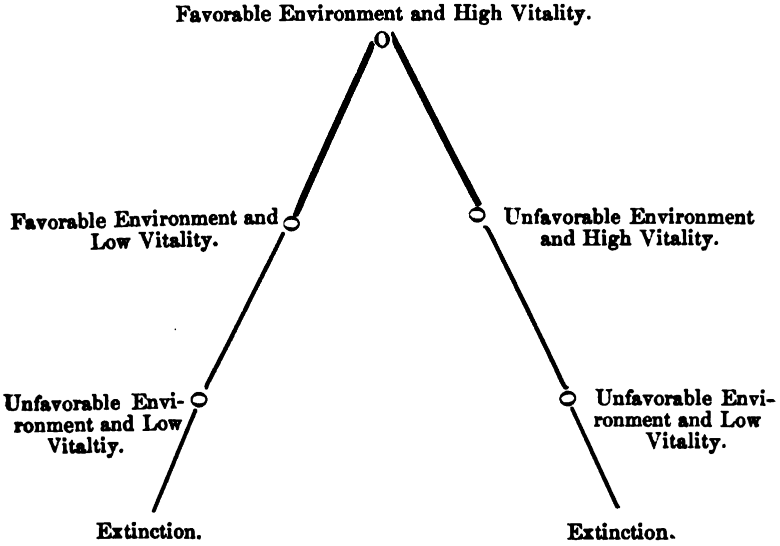
3



4

Typhlogobius.

High Vitality, for while these terms may not be co-existent upon the first appearance of a species they must quickly become so. A species originates, if we are to accept the Darwinian hypothesis by reason of its preponderant adaptation to new conditions, and if at first that adaptation is tentative or accidental, it soon becomes assured and necessary, upon the *settling down* of species and environment into a complete reciprocity. We then may expect two similar but contrasted stages to succeed this original, initial state, as is seen in the subjoined diagram; these stages presenting equivalent *numerical* zones, to be followed by two similar and identical stages, which in turn precede the extinction of the species.



The conjecture here delineated shows a species beginning under the favoring conjunction of vitality and adapted environment, rising in *numerical intensity* until a weakening of these elements sets in, and the species begins to decline in numbers. It may decline along a line of lessening vitality with environment constant, or, it may decline along a line of increasingly hostile surroundings with vitality constant, and it may be assumed that a stage of equipoise may be reached along either

of these lines wherein, however, the factors of environment and vitality are oppositely related. There would then be two stages of equal numerical efficiency, opposite in conditions but equivalent in effects, favorable environment and low vitality, and unfavorable environment and high vitality, and succeeding these as an inevitable sequence comes at the end of either road of retreat, the final stage of unfavorable environment and low vitality and the extinction of the species. Along either of the avenues of deterioration the numerical intensity is supposed to decline similarly but this superficial resemblance covers a radical contrast of agencies and we are brought to consider two kinds of strain; the strain of internal weakness, and the strain of external disparity. This introduces a crucial question we think in reference to the Darwinian hypothesis. That hypothesis assumes that species are perpetuated by the concordance declared between them and their surroundings, and it seems enclosed in this wide opening statement, that the Darwinian must allow a certain power of *provocation* upon organisms from exterior conditions, viz., that the inherent variability (fully emphasized by Darwin) of organisms is stimulated by changing environment while it should be more quiescent under unchanged circumstances of life. Without at present pressing this question the inference, we think, is reasonable. Therefore, in establishing a line of numerical decline for a species we have in this suggestion a form of test as to whether that decline arises from changing environment or changing vitality. If it proceeds from changing environment it will be, upon the Darwinian theory, accompanied by specific offshoots, and the disappearing species will sink from sight amidst the emergence of related species; but, if it proceeds from devitalization it will display a species dying as it were alone, unattended by the growth of related varieties, and passing away without those bequests of derivative forms which, in the other instance, represent the yet internally vigorous species struggling to maintain its empire under the guise of modified offspring. These propositions will, it may perhaps be conceded, repay more careful and detailed application to zoological history, as it has been written in the successive ages of geology.

THE DEVELOPMENT OF THE WING OF STERNA WILSONII.

BY VIRGIL L. LEIGHTON.

Although various students have investigated the structure and the development of the wing of the bird, many points still remain unsettled, and prominent among them, the relations of the carpal elements, the number of digits present and the comparison of these digits with those of the normal pentadactyl manus. Professor J. S. Kingsley suggested to me to attempt the solution of some of these problems and the studies detailed below were carried out in the Biological Laboratory of Tufts College under his direction. To him I owe the material—embryos of various stages of Wilson's tern, *Sterna wilsonii* from the Island of Penekese, Mass.—which formed the basis of my work.

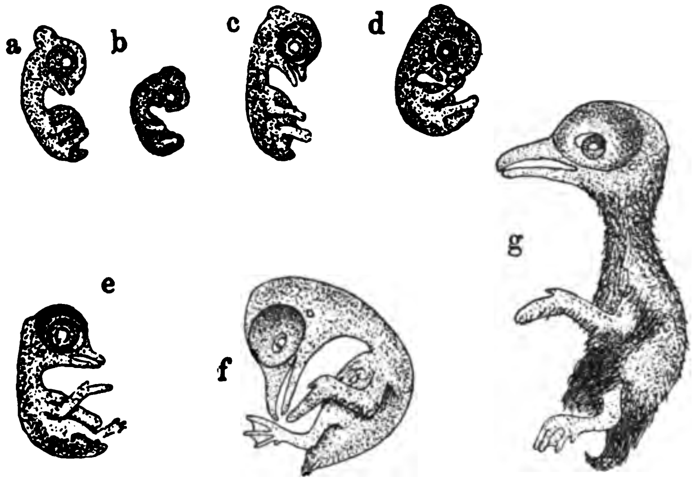
The alcoholic material was studied both in toto by clearing with oil of clove, and by means of serial sections. The latter proved far preferable and much more dependence can be placed upon results obtained in this way, especially with the younger embryos than by the more common methods of dissection and clearing in essential oils. The figures of structural details which illustrate the paper were obtained from reconstruction projections of the sections and are magnified twenty diameters. I am not able to state the ages of the various embryos, but this is a matter of little importance since the approximate development can readily be made out from the figures of the various stages, each natural size. The numbering of the separate stages is entirely arbitrary.

I might state here, incidentally, that I have also studied to some extent the foot of the tern and I find in it, as has already been pointed out by other observers, (Miss Johnson, Studer, W. K. Parker and others) a fifth metatarsal present.

STAGE I, (FIG. 1).

At this stage (fig. a) the principal elements of the wing are becoming differentiated. The radius and ulna are entirely

cartilaginous, except a small portion at their distal ends where they are least developed. In the proximal row of carpals are two masses of rapidly forming cartilage (radiale and ulnare) each of which appears to have two centers of chondrification.



The larger (the radiale, *re*) is almost divided into two parts; of these the larger and outer one is somewhat triangular in shape and is fitted upon the distal end of the radius, the smaller and inner one is nearly circular and is contiguous to the inner margin of the distal end of the ulna. The ulnare is composed of two oval centers, the proximal being about half the diameter of the distal one, thus giving the whole element a wedge-shaped appearance with its narrow end passing just outside the outer margin of the ulna.

The distal carpals are represented only by a thickening of tissue, or "procartilage" of Parker, showing as yet no differentiation into separate elements. There are *four* radiating digits represented for the most part by "procartilage," but metacarpals II[1] and IV are becoming cartilaginous at their proximal ends and metacarpal III is two-thirds cartilage.

STAGE II, (FIG. 2).

This stage (fig. b) is but slightly more developed than the last. The cartilage is a little more pronounced, and digits II,

---

[1] For the numbers to be given to the digits, see below.

III and IV have become longer, III and IV being segmented. The fourth digit has become free from the central mass, and more nearly approximated to digit IV. In the distal carpal series there are two masses of cartilage: on the radial side a mass which represents the combined carpales II and III, and on the side of the ulna carpale IV, an oval mass contiguous proximally to the distal lobe of the ulnare and distally to its own metacarpal.

STAGE III, (FIG. 3).

In this stage (fig. c) there are several things to be noted. The spreading of the digits is not so great and the whole manus is beginning to flex towards the ulnar side, thereby displacing some of the carpals from their normal position. The elements are now all perfectly distinct, the radiale has entirely lost its bibobate appearance, and is now of an irregular shape, touching the radius and ulna and the approximate surface of the conjoined carpales II and III. The ulnare is now entirely outside the ulna, but, what seems most remarkable, its proximal portion is now about twice the size of its distal lobe, while in the stages previously described it is about half as large. The distal lobe is circular, the proximal wedge-shaped, with the small end proximal. Carpale II+III is the last carpale to chondrify, but is now all cartilage except a very small portion of its proximal end. It is an elongate mass, placed somewhat diagonally to the present axis of the limb. It is contiguous distally to the approximate surface of metacarpals II and III and carpale IV; proximally to the radiale. Carpale IV retains the same relative position as in earlier, except that it has approached closer to metacarpal III. Digits II and III have each added a segment, that of the former is partly cartilaginous, the latter is all procartilage. Metacarpal IV has approached metacarpal III and its single phalanx is entirely cartilaginous. Metacarpal V has the same appearance as in previous stages, but is farther from metacarpal IV.

STAGE IV, (FIG. 4).

The specimen which forms the subject of this stage (fig. d) is in some respects slightly more developed than stage III, in

other respects less so. The manus is not flexed so much, and consequently the ulnare has not been pushed so far outside the ulna. In this specimen, unlike the others, the two lobes of the ulnare are about equal in size, the distal one oval, the proximal wedge-shaped. The radiale retains its bilobate appearance as described in stage I. Carpale II+III forms a lunate mass of fully developed cartilage about the head of metacarpal III. Carpale IV is slightly smaller relatively than in the previous stage; the digits are essentially the same.

STAGE V, (FIG. 5).

In the specimens (fig. e) which forms the basis of this stage, the manus now assumes very nearly the form which it has in the adult bird. The radiale is irregular in shape and fitted to the distal end of the radius, the inner distale margin of the ulna and the approximate surface of carpal II+III. The distal lobe of the ulnare is here at a minimum in comparison with the proximal lobe; it is now closely appressed to carpale IV which is wedged between it and carpale III. Metacarpal II has approached metacarpale III and on its radial side is developed a large projection or "trochanter." Its proximal phalanx is entirely cartilaginous, its distal one is just beginning to appear. Metacarpal III now bears three phalanges, the distal one not yet cartilaginous. Metacarpal IV has assumed a position parallel to metacarpal III, but is not yet united to it. Metacarpal V has approached metacarpal IV near its proximal end.

STAGE VI, (FIG. 6).

In birds of this age (fig. f), carpales II, III and IV have entirely coalesced, and, together with metacarpal II, form a solid socket into which fits the head of metacarpal III. Metacarpal II bears two phalanges; metacarpal III three, their distal phalanges being unequal. Metacarpal V now touches metacarpal IV and is not so near the proximal end as in earlier stages.

STAGE VII, (FIG. 7).

There is little in this stage (fig. g) to note except metacarpal V. This is now an oval disk closely applied to the ulnar flexor surface of metacarpal IV, about one-ninth of the distance from the proximal to the distal end. It no doubt finally unites with metacarpal IV at that point.

COMPARISONS.

INTERMEDIO-RADIALE. In Sterna in the earlier stages these two elements are distinct (fig. 1); later they become so completely fused that they cannot be distinguished, although, exceptionally, (fig. 4) they partially retain their individuality for a considerable time. Similar conditions have been noted in several birds, *e. g.*, Opisthocomus, *Fulco tinnunculus* and chick by Parker and *Cypselus melba* by Zehntner ('90). In other birds the separation has not been described, possibly from the fact that the proper stages have not been studied.

ULNARE-CENTRALE. My observations here closely agree with those of Parker on the ducks and auks, there being the same tendency to subdivision of the cartilage mass into two elements which he shows. One of these is, beyond doubt the ulnare, but I confess I am not so certain of the other which I call centrale in deference to his better opinions. The conditions shown in fig. 1 where the two portions of this element are clearly shown, leads one to the conclusion that the distal lobe may possibly belong to the series of carpales, in which case it would be that of the fourth existing digit. In fig. 5 again the arrangement is such as to support such a view, while on the other hand, in none of the earlier specimens have I seen it in such a position as to indicate that it should be regarded as a centrale. In *Chloëphaga poliocephala* Parker ('90) describes this bone as divided into three portions, the two distal of which he terms centrale 1 and 2. It would rather seem as if we had here to do with a true centrale, while Parker's centrale 1—clearly, according to position, equivalent to the single one which I find—must be regarded as a fourth carpal. (Cf. Parker '90, pl. 5, fig. 14). Studer, according to the

single figure copied by Wiedersheim, has different ideas. He has no such projection from the ulnare, but in his figure carpale I+II projects up between radiale and ulnare and the projecting portion is the centrale. Zehntner, on the other hand, ('90) has the intermedium united to the ulnare, the centrale to the radiale, conditions which certainly do not occur in Sterna.

CARPALS. Unless we regard the "centrale" of the preceding paragraph as in reality a carpal, Sterna never possesses more than two distinct elements in the distal carpal series. Of these that on the radial side is the larger. When chondrification begins it occupies a position (fig. 2) at the base of metacarpal III; later (figs. 3, 4) it extends radially towards metacarpal II, and even at times (fig. 4) exhibits a marked bilobate appearance. From these facts as well as its subsequent history I regard it as a compound body, the carpales II+III of the normal pentadactyle hand, the distal carpal II of Parker and most other students of Avian osteology. Concerning the "pentosteon" of Shufeldt I can say little. This author ('82^b p. 691, footnote) gives this name to a small bone found by him in Centrocercus lying at the base of the plantar surface of the second (my third) metacarpal. The name was given because it was the fifth carpal bone discovered, and because it was noncommittal as to its homologies. Parker now finds the same bone in ducks and auks, occupying the same position, and regards it as carpale I. This interpretation, however, seems to me faulty, as the bone is not in the proper position for such identification, nor have we any torsion or stress which could account for such translation. It would appear rather to belong to the same category as the pisiforme, but since I have not found it in Sterna I can offer no further observations upon it.

The other free carpal element, carpale IV, is clearly but a single element and not a compound structure like that described by Zehntner, Rosenberg and others. Studer, in the penguin, also figures a broad element in this position which he doubtfully regards as compound. In Sterna this element at its first differentiation is no wider than the fourth metacarpal, and as long as it retains its free condition it remains re-

latively of the same size. Later (fig. 6) it becomes united with carpale II+III, the whole forming a single piece equivalent to the separate os magnum and unciforme of some birds.

METACARPALS. The only metacarpal which requires notice is V (IV of many authors). This has been more or less perfectly described by several students since its first discovery by Rosenberg ('73). This author describes it in the chick as a distal process of a common mass of cartilage which clearly contains *two* carpal elements, IV+V, since to it is also joined metacarpal IV. In the case of his figures there can be no doubt that this distal prolongation is a true digital element, as it is clearly homonomous with the other metacarpals. It is to be noted that according to Rosenberg this new metacarpal lies at a lower level than the others, being flexed towards the palmar surface. Zehntner ('90) finds the same element in *Cypselus melba*, but existing there, as in Sterna, as a piece distinct from the basal (carpal) element with which it is at first joined in the chick. According to Zehntner after 9 or 10 days, this metacarpal "geht.... bei Cypselus einen vollständigen Atrophie." This is certainly not the case in Sterna, nor is it in those forms studied by Parker. Here it retains its discrete nature for sometime and in the fowl, toucan and cariama it even becomes ossified before its final union with the basal end of metacarpal IV.

That this is a true metacarpal is, I think beyond question. Owing to the method of study adopted by Parker he failed to recognize its earlier conditions, and his observations, unsupported by other evidence might be interpreted, as has been done by several, in another way. However, the evidence adduced by Rosenberg, Zehntner and myself, clearly removes this from the category of tendinous ossifications, the pisiforme and the like.

Naturally the structures which I have described should be compared with those of the reptiles, but this to be at all adequate would require a detailed knowledge far greater than I possess. It is to be noted, however, that if, as contended in the next section, the avian "pollex" is not the first digit of the pentadactyle hand, a portion of the reasons adduced for

regarding the Pterodactyls as widely removed from the birds is removed.

THE HOMOLOGIES OF THE DIGITS.

In the wing of the adult bird only three digits at most attain full development, and, since the birds have descended from pentadactyle forms, it becomes a matter of some importance to compare these three with those of the normal hand; in other words to ascertain which digits have been lost in the process of evolution. Naturally many attempts have been made to solve the problems involved, and within the last decade four different views have had their advocates, though naturally some of these ideas of homology date back to a more remote period.

Thus Gegenbaur ('64), reasoning from the apparent tendency towards reduction of the digital elements on the ulnar side of the crocodilian manus, concludes that the persistent digits of the bird wing are the I, II and III of the normal pentadactyle hand. In this he has had many followers, among them Rosenberg ('73), Huxley ('71), Jeffries ('81), Jackson ('88), and Parker ('88). For this view there are many more arguments than the one mentioned above, and Dr. Jeffries has given an able summary of them.

A second view is that of Owen, according to which the digits in question are II, III and IV. This is based partly ('36) on the fact of the absence of the radial artery, which would indicate reduction on the radial side of the manus; and partly ('62) on features supposed to exist in the British Museum specimen of Archæopteryx. In this there are apparently four digits present in connection with the right wing, but as these show considerable dislocation, one may, as suggested by Professor Owen, have belonged to the other side. This view has fewer supporters than the other, among them Morse and Coues. Morse ('72) contributes not a little in support by his advocacy of the law of digital reduction as a valid argument in this connection. That Coues supports the same view I take partly on the statement of others and partly from the fact that, while in the text of his " Key " ('87), he gives both views, the num-

bering of the digits is II, III, IV. In an earlier paper ('66) he accepts the numbering I, II and III. Here, too, must be enumerated Shufeldt, who states ('82, p. 616) that he has always adhered to this view, but adds "the fact, however, that the first phalanx of the manus of aves is the homologue of the pollex of the pentadactyle limb seems to be gaining ground." I have not found any further reference to this subject in his subsequent osteological contributions further than this usual reference to the radial digit as the pollex.

Mr. Hurst ('93) has advocated a third system of numbering according to which the digits are III, IV and V. An analysis of his reasons will be given immediately when dealing with the arguments for the enumeration adopted in the present paper.

The fourth system is that of Tschan ('89) who according to Zehntner ('90) proposes to regard the permanent digits as I, II and IV. He bases this on the discovery by Parker ('89) of a slip of bone in chick,[2] Musicapa and many Gallinæ as occurring between the second and third of the persisting digits. This, says Tschan, is the true digit III. But Parker further describes similar slips as occurring on the outside of the "pollex" and between the first and second permanent digits as well as a true fourth metacarpal on the ulnar side of the hand. Tschan suggests that the first of these might be the "prepollex" but even with the admission of this doubtful element, there would be one superfluous digit. This together with the utterly anomalous type of reduction which it presupposes—the disappearance of digits in the middle of the manus—is sufficient to discredit this view.

That there is developed a fourth digit in the avian manus is beyond question, and the fact that this comes upon the ulnar side of the three permanent fingers is sufficient to invalidate the nomenclature, III, IV and V of Hurst. Hurst refers to Parker's fourth digit as appearing to be the *os pisiforme*, and since Parker had only the later stages, there would be some plausibility in this view. This possibility, however, disappears

---

[2] It was discovered, as Parker points out, long before by Heusinger ('20, pl. IV f. 10) in the chick, persisting for sometime as a separate bone.

when we study not only my figures 1 and 2, but the figures of Rosenberg and Zehntner. In the figures just cited the temporary digit is just as prominent as is the "pollex" and no one without a theory to support would regard it other than a digit. Then too, as Rosenberg's figure shows, it bears no connection to the ulnare, but is a distinct outgrowth from the outer distal angle of carpal III+IV.

We are then left to choose between the formulæ I, II and III and II, III, IV, and though the apparent weight of authority is in the other direction, I am strongly inclined towards the second alternative, for the following reasons: First comes the law of digital reduction advocated by Morse, by which in other groups digit I is first to disappear and then V. Further, when further reduction occurs in birds, and a single digit is left as in the Apteryx and the Cassowaries, the reduction has occurred on both sides of the persisting digit, which, according to my nomenclature, would be digit III. This implies a symmetrical reduction, the other view involves the disappearance of digits I, III, IV and V, a condition, so far as I am aware, without parallel.

Then too, Archaeopteryx, in the light of Hurst's later studies presents some evidence. As noted above, Owen thought he had found evidence of a true digit I in the British Museum specimen, but on the discovery of the Berlin specimen this idea was dropped and the conditions presented by the new example form the chief argument in Jeffries' summary already alluded to. It would, however, appear that most recent figures of the Berlin specimen and the conclusions based upon them are not to be relied upon. This can be at once seen by comparing for instance the figure of Archaeopteryx given by Zittel in his Paleontologie with the photographic reproduction which illustrates Hurst's article.[3] In the Berlin specimen three digits in the wing are clearly visible, and it has been assumed that these were the only ones. Hurst, however, points out that the position of the feathers is such that they could not have been borne on these digits as in ordinary birds,

---

[3] The plate in the Standard Natural History (Vol. IV, facing p. 22, 1885) approaches very closely the figure of Hurst.

but that there must be (at least one) digits buried beneath the feathers, and in just the place where the missing finger or fingers should come is an evident ridge in the stone.

If we may call upon the effects of use and disuse, the conditions presented would also tend to favor the reduction of the digits on the radial side, for it is the ulnar phalanges which must bear the stress of the wing; the fingers on the radial side, having but few small feathers, would be most likely to disappear.

Jeffries invokes also the distribution of the nerves, but to my mind his evidence is not conclusive; besides it is directly negatived by the distribution of the blood vessels as was pointed out above.

We may conclude, then, that the only conditions possible are either I, II and III, or II, III and IV, and that until some evidence be found of the actual appearance of a fifth digit on the ulnar side, that there is at least as much reason for the second as for the first formula. In regard to the first, Hurst remarks, it "is in no case, so far as I am aware, supported by any evidence whatever. I believe it to have originated from the pre-Darwinian statement that the Ala spuria is 'analogous to the thumb;' while the other two digits are called simply 'second' and 'third;' that is, *second and third digits* not of the pentadactyle but *of the tridactyle fore-limb*. Such phrases written on the then undoubted hypothesis of special creation and of fixity of species, could obviously not mean that the three digits called 'thumb' and 'second' and 'third' had been evolved from the digits I, II, III of the pentadactyle fore-limb of an ancestor; the author did not believe that birds ever had such an ancestor. The transcription of such phrases into post-Darwinian treatises, without consideration of the new meaning which they would thus gain from the new context, appears to have been the origin of the error."

CONCLUSIONS.

CARPALS. There are at least seven elements in the carpus. In the proximal row there are two free elements (intermedioradiale and centralo-ulnare) both of which are divided in the

early embryo, and represent, morphologically, the radiale, intermedium, centrale and ulnare. In the distal series there are also two free elements, one of them (carpal II+III) being evidently compound.

DIGITS. There are four distinct metacarpals. The first (II) supports two phalanges, the second three, the third one, and the fourth none. The distal phalanges of m. c. II and III are furnished with claws. *M. C.* V arises as a distinct digit, subsequently becomes free, and finally unites with m. c. IV.

NUMBERING OF DIGITS. The persistent digits of the birds wing are either I, II and III or II, III and IV, the bulk of evidence being in favor of the latter enumeration.

LITERATURE CITED.

'66 **Coues, Elliott.** The osteology of Colymbus torquatus; with notes on its myology. Memoirs Bost. Soc. N. Hist., i, 131, 1866.

'87 **Coues, Elliott.** Key to North American Birds. Third Edition. Boston, 1877.

'20 **Heusinger, C. F.** Zootomische Analekten. II. Ein Beitrag zur Metamorphose des Vogel-Flügels. Meckel's Archiv f. d. Physiol., vi, 546, 1820.

'72 **Huxley, Thomas Henry.** A manual of the anatomy of vertebrated animals. London, 1871.

'93 **Hurst, C. Herbert.** Biological Theories, VIII. The digits in a bird's wing; a study of the origin and multiplication of errors. Natural Science, iii, 275, 1893.

'88 **Jackson, W. Hatchett.** Forms of Animal Life..... by the late George Rolleston. Second Edition. Oxford, 1888.

'83 **Johnson, Alice.** On the development of the pelvic girdle and the skeleton of the hind limb in the chick. Quar. Journ. Micr. Sci., xxiii, 399, 1883.

'81 **Jeffries, J. A.** On the fingers of Birds. Bulletin Nuttall. Ornith. Club, vi, p. 6, 1881.

'72 **Morse, Edward S.** On the Tarsus and Carpus of Birds. Ann. Lyceum Nat. Hist., N. Y., x, 1872.

'36 **Owen, Richard.** Article "Aves." Todd's Cyclopedia of Anatomy and Phys., i, p. 265, 1836.

'63 **Owen, Richard.** On the Archæopteryx of von Meyer, with a description of the fossil remains of a long-tailed specimen, from the lithographic stone of Solenhofen. Phil. Trans., Vol. 153, p. 33, 1863.

'89 **Parker, William Kitchen.** On the structure and development of the wing in the common fowl. Phil. Trans., Vol. 179B, p. 385, 1889.

'90 **Parker, William Kitchen.** On the morphology of the duck and auk tribes. Royal Irish Academy, "Cunningham Memoirs," No. VI, 1890.

'37 **Rosenberg, Alex.** Ueber die Entwicklung des Extremitäten-Skelettes bei einigen durch Reductionen ihrer Gliedmassen characterisirten Wirbelthieren. Zeitsch. wiss Zool., xxiii, 116, 1873.

'82[a] **Shufeldt, R. W.** Osteology of Speotyto cunicularia hypogæa. 12th Rept. U. S. Geol. Survey, (Hayden) p. 593, 1882.

'82[b] **Shufeldt, R. W.** Osteology of the North American Tetraonidæ. *t. c.*, p. 653, 1882.

'89 **Studer, Th.** Die Forschungsreise S. M. S. "Gazelle" in der Jahren 1874 bis 1876. Herausgegeben von den hydrograph. Amt der Admiralität. III Theil: Zoologie und Geologie. Berlin, 1889. (Cited from R. Wiedersheim, 1893).

'89 **Tschan, Alfr.** Recherches sur l'extremité antérieure des Oiseaux et des Reptiles. Dissertation, Genève, 1889. (Cited from Zehntner, 1890).

93 **Wiedersheim, Robert.** Grundriss der vergleichenden Anatomie der Wirbelthieren. Dritte Auflage. Jena, 1893.

'90 **Zehntner, Leo.** Beiträge zur Entwicklung von Cypselus melba nebst biologischen und osteologischen Details. Archiv für Naturgeschichte LVI, I, 189, 1890.

EXPLANATION OF THE FIGURES.

The illustrations in the text show the embryos natural size. It is to be noted that fig. A, showing a smaller embryo, had a wing more developed than fig. B. All other figures are projections of camera drawings and are each magnified 22 diameters.

REFERENCE LETTERS.

c carpale
h humerus
r radius
re radiale
m. c. metacarpal.
u ulna.
ue ulnare.
II–IV and I–IV digits.

Fig. 1. Manus, stage I, showing carpus and digits as procartilage with several cartilaginous elements. Digit V is plainly shown.

Fig. 2. Manus, stage II. Three carpals are now seen and metacarpal V has become distinct from the carpal mass.

Fig. 3. Manus, stage III. The digits are now broken into phalanges and the flexure of the hand to the ulnar side is forcing the ulnare out of its normal position.

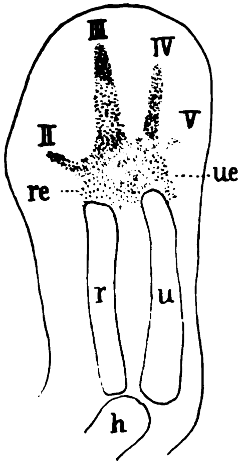
Fig. 4. Manus, stage IV. The radiale shows tendency to division into radiale and intermedium.

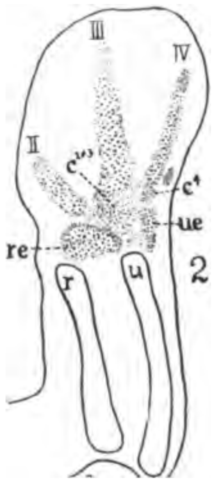
Fig. 5. Manus, stage V. Elements now beginning to ossify. Digits II and III are terminated with claws.

Fig. 6. Carpals and metacarpals, stage VI. Carpals united; metacarpal V approximate to metacarpal IV.

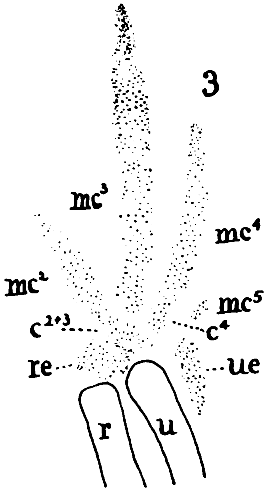
Fig. 7. Conditions just before hatching. Metacarpal V joined to metacarpal IV.

PLATE XXV.

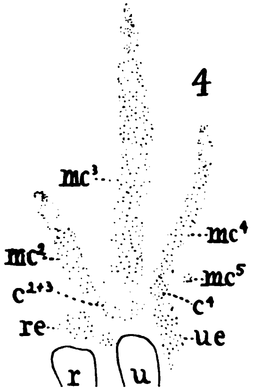




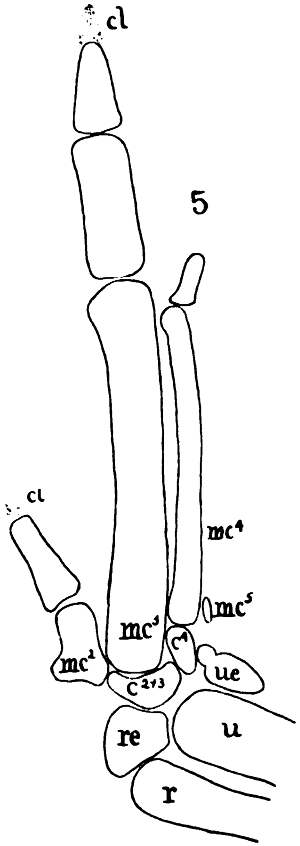
2



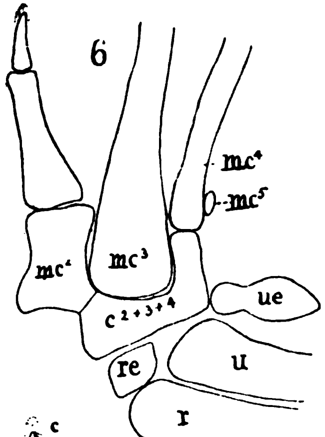
3



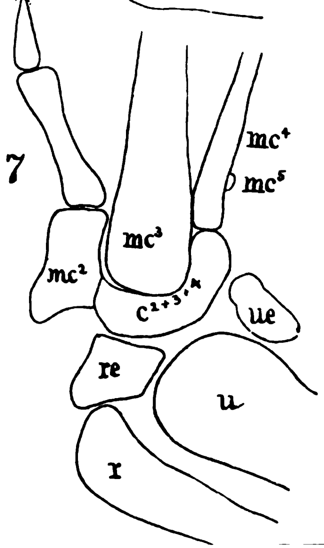
4



5



6



7

A LITTLE KNOWN JAMAICAN NATURALIST, DR. ANTHONY ROBINSON.

By T. D. A. Cockerell.

There are, in the library of the Institute of Jamaica, some interesting old manuscripts, together with a number of drawings which constitute almost the sole record we have of the scientific labors of Dr. Robinson in the island. The drawings are original but the manuscripts are copied from the papers left by the learned doctor, which latter appear to have been lost. The following notice is appended to the copy:

"This [is a] faithfull transcript of Mr. Robinson's loose unconnected and detach'd papers, by Rt. Long, who has revised the whole and corrected the errors of copyist thro-out. Septr., 1769.

"Anthony Robinson, Chirurgeon, formerly of Sunderland by the Sea in Durham, but lately of Jamaica."

In the Jamaica Institute is a pencil drawing of the doctor, by Edward Long, in connection with which Mr. F. Cundall has written the following biographical note:

"Anthony Robinson, surgeon and botanist: a native of Sunderland, England, where he was apprenticed to his father, a surgeon and apothecary: early turned his attention to botany: came to Jamaica: made a collection of several hundred figures and descriptions of Jamaica plants and animals: the drawings are in the Institute of Jamaica, with a copy of the MS. made under the supervision of his friend, Robert Long. (The original MS. is lost). His notes were used by Lunan in his "Hortus Jamaicensis," and by Gosse in his "Naturalist's Sojourn" and "Birds of Jamaica." The House of Assembly voted him £140 in 1767 for his discovery of the method of making soap from the juice of the Coratoe. *d.* 1768." (Journ. Inst. Jamaica, Vol. 1, p. 327).

Although Dr. Robinson did not himself publish, some of his notes have been used by later writers, as stated above. The

greater part of the manuscript, however, is still unpublished, and not long ago it was debated whether the ornithological observations should not be issued by the Institute, accompanied by a selection from the colored drawings. This project after consultation with an experienced ornithologist, was abandoned, at least for the present, as so large a portion of the manuscript consists of elaborate descriptions which would practically duplicate those in existing works. Had these descriptions been published when Dr. Robinson wrote them, their value would have been very different.

The extracts from the manuscript by Gosse in his well known works sufficiently testify to the scientific zeal and knowledge of Dr. Robinson, although his methods were rather those of an age now past. I brought with me from Jamaica copies of several unpublished portions of the manuscript, and will give a few extracts, both to illustrate the character of the man and put on record observations which, although so old, have not lost their value.

1. The Alligator (so-called) of Jamaica, *Crocodilus americanus.* The following selections are from a long account of this animal:

"A very small alligator was put into rum by Mr. Walker, then of Old Harbour, now of Kingston, and according to the nicest reckoning with a watch or other time's measure, liv'd about a quarter of an hour in that spirit."

Of another specimen, "the stomach's contents were bird's feathers (aquatic most probably), joints of crabs claws, and little living white slender worms, with some small pebbles."

The parasitic worms deserve attention; have they been described? In the horned lizard (*Phrynosoma*) of this part of the world (N. Mex.) one finds also such worms.

Dr. Robinson proceeds to describe the crocodile's external features and anatomy: "The guts measuring from the stomach to the end of the intestinum rectum were fifteen feet long, uncoil'd.

"The time the young alligator continued under water was to the outmost but two minutes, as we proved by repeated trials, puddling and disturbing the water in order to keep him under thro' fear as long as his nature would admit.

" He seldom raised more than his nostrils above the water, he ever delv'd at the near approach of any person.

" Taken out of the water, the creature breath'd or made an indraught of air to his lungs, from five to ten slow and regular respirations, and at the end of the fifth, or the tenth time, was a total cessation from breathing for about one minute."

In another place he writes: " Once this animal was observ'd to continue under water upwards of ten minutes.

" I turn'd the alligator on his back and while I staid by him he lay as if lifeless without the least motion, as I observ'd lizards do when turn'd on their backs; I retir'd for about three minutes out of his sight, and on my return he had recover'd his first situation.

" The tail's extreme I caus'd to be broil'd on the creature's dying, and ate of it. The flesh was extremely white, firm, sweet, moist and juicy, as turtle in whiteness but not so dry, not the least musky in taste or smell. My little spaniel dog ate very greedily of it." This alligator was a young one.

The true alligator, it should be remarked, is not found in Jamaica.

2. *Elaps*, probably *E. fulvius;* not Jamaican.

" A snake known by the name of the poison snake among the Indians, but among the Europeans by that of Barber's pole. The Indians have no cure for the bite of this creature, it being mortal in 10 or 15 minutes, the patient bleeding at mouth, eyes, and nose, and thus letting out his life."—(Charles Harris).

" The gentleman who wrote the above is son to Revd. Mr. Harris, late Rector of St. Elizabeth [Jamaica] who was in company with an Indian that died from a bite of the above snake, which he takes to be a species of that received from Walrond Teason, Esq., which came from the Spanish main. I have described it the Ring Snake because its body is surrounded with black and yellow rings. Mr. Harris saw the above on the Moskito shore."

The snake is now commonly called the coral snake, but the title mentioned, " Barber's pole," is more suggestive of its appearance. No poisonous snake inhabits Jamaica.

3. Names of lizards. Dr. Robinson writes Guana uniformily for what is now called the Iguana; and for what Gosse writes Galliwasp (*Celestus occiduus*), Robinson has Gully Wasp. In another place Robinson calls the same lizard Gully Asp, which explains at once the origin of the name. He observes: "The lizard tribe in general have nothing poisonous in their bite, but the Gully Wasp is strongly suspected. Cattle and mules are said to be often bit by them and so swell and die."

This notion reminds one of that current in New Mexico, of the fatal effects of Phasmids on cattle when eaten by them.

4. The Gully Asp, *Celestus occiduus.*

"The Gully Asp inhabits morasses and the banks of rivers, and gullys in the plains and mountains. They live upon fish, fruit and even human excrements. They stand upon the banks of rivers, etc., and watch for the fish coming within reach, when they suddenly spring upon them into the water and bring them out in their mouths to the shore, where they eat them. I have been informed that they are oviparous and lay eggs as big as those of a pullet, but I have not yet seen them. I have often been inform'd that no animal will eat the carcass of this creature, and the following instance seems to prove them unwholesome:

"Dr. David Miller inform'd me that a few days ago an acquaintance of his in his way to Mr. Miller's happen'd to kill a small Gully Wasp of about fifteen inches long and brought him to his house and flung him into an inclos'd square where he kept a young alligator of about five feet long. The alligator immediately swallow'd the Gully Asp. This was about 11 o'clock in the forenoon. About four hours after, the alligator (Robinson writes it aligator) was observ'd to jump and flounce about the square, knocking its head and tail against the stockades, seeming to be quite mad and frantic with pain, and continued in the manner till night, when he died. Therefore, the Dr. concluded that the Gully Asp had poison'd him; he says besides that no creature will touch the dead Gully Asp. it should seem that most animals by a natural instinct shun the carcass, and therefore avoid the certain destruction that would happen to them by eating them.

"Yet I believe it is not the flesh of the Gully Asp that is pernicious for two reasons. First, because the negroes at Egyp(t) Plantation often eat them, and secondly, I cannot think that any of the fleshy part could be dissolved in the cold stomach of the alligator in so short a space of time as four hours, besides the hard scales of the Gully Asp's skin would hinder the digestion not a little. What part of this animal is poisonous? perhaps the viscera, but which? This might be known by giving some creature, as a dog or cat, the different parts of the animal to eat at separate times."

Gosse does not admit that this lizard has any injurious properties. The above anecdote about the alligator (crocodile rather), though interesting, is hardly conclusive by itself. Later, Dr. Robinson writes:

"May the 25th, 1760. I was at St. Tooley's, where the overseer, Mr. Watson inform'd me that the Gully Asps about that estate were very fierce and would seize a man, and that their bite, he assur'd me, was certainly venomous. Memorandum to inquire more strictly into this matter." Later he writes:

"A gentleman in St. Elizabeth's informs me that in the mountains there they have a Gully Asp entirely black, which is said to be poisonous, and that if it bite either man or beast they certainly die. He gave me an instance of one biting a girl on the toe (I think), who expir'd a few hours after receiving it. . . . However, this gentleman and almost all other considerable persons in this parish and the next seem to look upon the Great Morass Gully Asp, which I think it may properly be call'd, as an inoffensive creature; the above-quoted person tells a story of a person who while he slept in the morass one night, laid hold of his cap and endeavour'd to pull it off. The gentleman observing this after the first tug, lay close, and quite mistaking it for a negro, resolving to watch him; and the next pull the Gully Asp gave he laid fast hold of him, but perceiving his error throw him backwards some yards. He says he has often fed them with offal, when he has been eating, and suffer'd them to run over his legs."

5. The following observations on a Cœlenterate which I will not pretend to determine, seem to have a bearing on some quite recently published researches.

"Small, clustering Actinea. Amongst the surrounding rocks of Booby Quay, *Actinia minima viride racemosa*, the clustering small green Actinea. These grew many together, they were about an inch long, of a round form like an earthworm. Their arms extended themselves to the diameter of one's thumb-nail, and nothing could be more pleasing than to lean down and observe some hundreds of these animals with their arms extended in the form of a stellate flower with its disc, which the mouth represents, and its rays the extended arms of a various green color as deeper and paler in circles, supported by deep green pedicels smaller than the fore-quill of a goose, and waving to and fro by the undulating motion of the water.

"From their bases are produc'd young ones, and from thence others which never fall from the mother or parent animal, as in the polypus, by which means, they grow in vast numbers, together so thick as to hide the rocks they grow upon entirely, and may be rais'd up as one body, where their bodies are observ'd to unite to one another. Their bodies are firmer and harder in handling than those of the common Actinea, nor do they shrink so much but only close their arms. They growing upon naked rocks so that they are always visible and taken by the incuriose (sic) to be a kind of sea-moss; at low water many of them are bare, at such times they never disclose or expand their arms."

Perhaps some reader will be able to supply the name of this "Actinea."—Agricultural Experiment Station, Las Cruces, New Mexico, March 4, 1894.

EDITORIALS.

—The Forty-Third Meeting of the American Association for the Advancement of Science took place in Brooklyn, commencing on August 15. The weather was propitious and members attended to the number of 475. Many meritorious papers were read, and the addresses of the Vice-Presidents presented science in its varied aspects. The introductory address, in reply to the welcome of the citizens of Brooklyn, by the President, Dr. D. G. Brinton, was an admirable exposition of the methods and aims of science. Four lectures were delivered in the evening—the address of the retiring President, Professor Harkness, and three by Messrs Fernow, DuChaillu and Cope. The citizens of Brooklyn entertained the Association with unusual hospitality in the matter of excursions. The neighborhood of New York offers many opportunities in this direction, of which the Association freely availed itself.

The Association has, for several years, missed from its meetings an important contingent of the workers of the country. We refer especially to the anatomists, embryologists and physiologists. The principal object of the Association is to present to the American public an illustration of the work done by the investigators of the country, that they may, in some degree, understand its value. The absence of these gentlemen reduces the value of the Association as an object lesson, and detracts from the force of the impression which the Association should make. Their absence diminishes the prestige of the workers in science in this country. Original research is but little endowed in America, and it is likely to remain so unless the investigators make themselves and their needs known.

The newspapers of Brooklyn gave good reports of the meeting, but those of New York, with some few exceptions, burlesqued the Association. This shows that mental degeneracy is not confined to the rulers of New York, but has gotten a strong hold on the alleged intelligence of the city, viz.: the Press. As New York, however, is not the United States, this matters little, except to New York.

The tariff bill which has just passed Congress contains the following provisions, which benefit scientific work in this country. The Congressional Committees which have prepared it have been interviewed from time to time by members of the committee appointed for that pur-

pose by the American Association for the Advancement of Science, with the result of placing on the free list the following items: Scientific books and periodicals devoted to original scientific research, and publications issued for their subscribers by scientific and literary associations or academies, or publications of individuals for gratuitous private circulation, and public documents issued by foreign governments; books and pamphlets printed exclusively in languages other than English.

All manufactures of metals not otherwise provided for, reduced from 45 to 35 per cent. ad valorem, or a reduction of 22 per cent.

These provisions almost remove the onerous and disgraceful tax on education and science, which characterized the McKinley bill. It only remains to continue the work, so well begun, of the removing the tax on philosophical apparatus. The Association continued the committee.

THE address of Lord Salisbury at Oxford before the British Association for the Advancement of Science, as its President, is a general review of the present status of selected leading questions in all of the great departments of scientific research. These are treated in a simple and straightforward manner, so as to be fully comprehensible to the lay member. The value of such an address, in informing the public of the nature of the problems which have been solved and are awaiting solution by scientific research, is great. It will also benefit the cause of science in England that so distinguished a member of the ruling class should espouse it in so conspicuous a manner. Lord Salisbury adopts the hypothesis of organic evolution, but, like Lord Kelvin, declines to regard Darwinism as a full exposition of it. Against it he appeals to the evidence of intelligent design to be seen in the organic world. He does not refer to the doctrine of kinetogenesis, which so well explains the nature of design. He is not, however, prepared to accept as a necessary corollary of the fact of evolution, the origin of man from preëxistent Quadrumanas, but calls it "not proven." This is probably as much as we can expect at this time from any one who is not a specialist in biology.

WE understand that among the animals imported from India by W. K. Vanderbilt for his park near Newport, R. I., are several mangooses. It is important that these animals should not escape from confinement, as they will inflict great injury on the native and domesticated fauna should they do so. They multiply rapidly and devour every living thing sufficiently important to serve them as food, whether they live under the ground, on the ground, or at a distance above the ground to

which they can climb. Having no natural enemies in the country, they would become a much greater evil than the English sparrow. Their importation, except for zoological gardens, should be forbidden.

SOME industrious persons are endeavoring to utilize parts of the great Palisade dyke of the Hudson for paving-stone. The New York journals are publishing protests against this vandalism, which will, we hope, have the effect of preserving this imposing feature of the scenery of that region.

RECENT BOOKS AND PAMPHLETS.

Bateson, W.—Materials for the Study of Variation, treated with special regard to the discontinuity in the origin of species. London and New York, 1894. From Macmillan and Co. Publishers.

Biological Lectures delivered at the Marine Biol. Lab. Wood's Holl, 1893. From the Laboratory.

Bulletin Cornell Univ. Agric. Exp. Station, No. 58, 1893.

Bulletin Wyoming Experiment Station. No. 14, 1893.

Calvert, P. P.—Catalogue of the Odonata (Dragon-flies) in the vicinity of Philadelphia, with an Introduction to the Study of this Group of Insects. Extr. Trans. Am. Entom. Soc., Vol. 20, 1893. From the author.

Campbell, H.—Differences in the Nervous Organization of Man and Woman. London, 1891. From H. K. Lewis, Publisher.

Cross, W.—Intrusive Sandstone Dykes in Granite. Extr. Bull. Geol. Soc. Am., Vol. V, 1894. From the Society.

Fedoroff, E.—Nouvelle méthode pour l'étude goniométrique et optique des cristaux appliquie à la mineralogie et à la pétrographie. Mém. du Comite Géol., Vol. X, 1893. From the Geol. Surv. of Russia.

Flint, W.—Statistics of Public Libraries in the United States and Canada. Bureau of Ed., Cir. Inform., No. 7, 1893. From the Bureau of Education.

Gage, S. P.—The Brain of *Diemyctylus viridescens* from Larval to Adult Life, and comparisons with the Brain of Amia and Petromyzon. Extr. Wilder Quarter-Century Book, 1893. From the author.

Haeckel, E.—Metagenesis und Hypogenesis von *Aurelia aurita*. Ein Beitrag zur Entwickelungsgeschichte und zur Teratologie der Medusen. Jena, 1881.

——Zur Phylogenie der Australischen Fauna. Abdruck aus Semon, Zoologische Forschungsreisen in Australien und dem malayischen Archipel. Jena, 1893. From the author.

Harshberger, J.—Maize. A Botanical and Economic Study. Contr. Bot. Lab. Penn. Univ., 1893. From the author.

Howes, G. B.—Notes on the Variation and Development of the Vertebral and Limb-skeleton of the Amphibia.——Notes on the Abnormal Sternium of *Hapale jacchus*. Extrs. Proceeds. London Zool. Soc., 1893.——On the Mammalian Pelvis with especial reference to the young of *Ornithorhynchus anatinus*. Extr. Journ. Anat. and Physiol., Vol. XXVII, 1893. From the author.

Lane, A. C.—Geologic Activity of the Earth's Originally Absorbed Gases. Extr. Bull. Geol. Soc. Am., Vol. V, 1894.

Lawson, A. C.—The Anorthosytes of the Minnesota Coast of Lake Superior. ——The Laccolite Sills of the Northwest Coast of Lake Superior, with a Prepatory Note on the Norian of the Northwest. Bull. No. 6, 1893. Minn. Geol. and Nat. Hist. Surv. From the Survey.

Lintner, J. A.—Fourth and Fifth Reports on the Injurious and other Insects of the State of New York. Extr. 41st Rept. New York State Mus. Nat. Hist. From the author.

LOCKWOOD, S.—Some Phenomena in Exuviation by the Reptiles. New York, 1893. From the author.

LUBIN, D. A.—Proposition Revolutionizing the Distribution of Wealth. Sacramento, 1893. From the author.

OSBORN, H. F.—Fossil Mammals from the Upper Cretaceous Beds. Extr. Bull. Am. Mus. Nat. Hist., Vol. V, 1893.——The Rise of the Mammalia in North America. Extr. Proceeds. A. A. A. S., 1893. From the author.

PILLING, J. C.—Bibliography of the Chinookan Languages, including the Chinook Jargon. Washington, 1893. From the Bureau of Ethnology.

SHUFELDT, R. W.—Nesting Habits of *Galeoscoptes carolinensis*. Extr. Auk, 1893.

SIEBENROCK, F.—Zur Osteologie des Hatteria-Kopfes. Aus den Sitzungsb. der kaiserl. Akad. der Wissensch. Wien. Mathem-naturw. Classe, 1893. From the author.

SMITH, E. F.—Experiments with Fertilizers for the Prevention and Cure of Peach Yellows, 1889–92. Bull. No. 4. U. S. Dept. Agric. Div. Veg. Path., Washington, 1893. From the Dept. Agric.

SMITH, J. B.—Catalogue of the Lepidopterous Superfamily Noctuidae found in Boreal America. Bull. U. S. Natl. Mus. No. 44, 1893. From the Smithsonian Institution.

SMITH, J. P.—Age of the Auriferous Slates of Sierra Nevada. Extr. Bull. Geol. Soc. Am., Vol. V, 1894.

SOKOLOW, N.—Die Untertertiaren Ablagerungen Südrusslands. Mém. du Comité Geol., Vol. IX, 1893. From the Geol. Surv. of Russia.

TARR, R. S.—Economic Geology of the United States. New York, 1894. Macmillan and Co., Pub. From John Wanamaker's.

TOPINARD, P.—L'Anthropologie aux Etats Unis. Extr. de l'Anthropol., 1893.

TRAQUAIR, R. H.—On *Cephalaspis magnifica*.——Achanarras revisited. Extrs. Proceeds. Roy. Phy. Soc. Edinburgh, Vol. XII. From the author.

TSCHERNYSCHEW, TH.—Die Fauna des unteren Devon am Ostabhange des Ural. Mém. du Comité Geol., Vol. IV, 1893. From the Geol. Surv. of Russia.

WHITMAN, C. O.—The Inadequacy of the Cell-Theory of Development. Extr. Journ. Morph., Vol. VIII, 1893. From the author.

WOODS, H.—Elementary Paleontology. Cambridge, 1893. From Macmillan and Co.

WORTMAN, J. L.—On the Divisions of the White River or Lower Miocene of Dakota.

——AND EARLE, C.—Ancestors of the Tapir from the Lower Miocene of Dakota. Extrs. Bull. Am. Mus. Nat. Hist., Vol. V, 1893. From the author.

ZITTEL, K. A. VON—Die geologische Entwickelung, Herkunft und Verbreitung der Säugethiere. Aus den Sitzungsb. der math.-phy. Classe der k. bayer Akad. d. Wiss., 1893. Bd. XXIII. From the author.

RECENT LITERATURE.

Louis Agassiz: His Life and Work; by Chas. Frederick Holder, M. D.[1] In this volume we have an appreciative history of Agassiz, in which the characteristics of the man, and the nature and progress of his work are most happily woven together. His ambitions, while still under the parental roof in Neuchatel, are recounted, and his biographer shows how early the dominant bias of a man's life may appear. We are told how his persevering devotion to his favorite pursuit did not prevent him from preparing for the practice of the medical profession, as a means of livelihood; and how, later, the opportunity of studying and reporting on the fishes brought home by Von Martius from Brazil, determined his future course. Every naturalist has been introduced to his life work in the science by especial facilities enjoyed for the study of some particular group. To Agassiz this group was the fishes, and his first works after that on the fishes of Brazil, were those on the fresh-water fishes of Europe, and the Fossil Fishes. But his highly appreciative mind was directed to all the problems offered by nature to human thought, and he quickly saw the importance which attached to the study of the Swiss glaciers. The far-reaching results of this work are now common knowledge; as it contains the key to the superficial geology of the temperate regions of the earth. The application of the glacial phenomena in geology is Agassiz's greatest achievement.

The history of Agassiz's work in the United States is interestingly told, and the narration of the Brazilian expedition is charming. The volume closes with a reprint of some of the memorials which expressed the feelings of naturalists at the time of his death, and with a bibliography.

The work is handsomely illustrated, largely from photographs made during the Brazilian expedition. It is a pity that better figures of the Brazilian fishes and turtles could not have been copied, as those in this book are mostly bad.

The personal characteristics of Agassiz are pleasantly described, and for this reason among others the book will be a valued souvenir to the friends who knew him. The author dwells especially on his great mer-

---

[1] 8vo, pp. 327, illustrated. G. P. Putnam's Sons, New York and London, 1893.

its as a teacher, which, indeed, cannot be exaggerated. He greatly popularized the pursuit of science in America, and the effect of his life and labors in this direction has been greater than that of any man, probably of many men. The pursuit of science was to him, as it should be to all, a duty undertaken for the elevation of human thought. That the visible nature is the material expression of the thoughts of God, was Agassiz's oft expressed belief. Doubtless he was correct, but the proof of it comes in a way different from that which this great naturalist anticipated; that is, through the direction of evolutionary descent. Perhaps if Agassiz had lived longer, he would have adopted this view, and embellished it as he did all his teachings.—C.

Nuttall's Ornithology.[2]—This hand-book of ornithology is published in two handsome volumes 8vo, of some 400 pp. each. It is practically a new edition of Nuttall's Manual, which has been out of print for several years, to which the editor has added brief notes relating the results of recent determinations in distribution and habits. The introduction is given exactly as it appeared in Nuttall's second edition, and the text of the biographical matter has been changed but little. To this Mr. Chamberlain adds a description of the plumage, nest and eggs of each species.

In his treatment of the subject, the author covers the entire area of the Eastern Faunal Province from the Gulf of Mexico to the Arctic Ocean. The nomenclature adopted is that of the Check List issued by the American Ornithologists' Union. The illustrations are mostly drawn especially for the work. They are of excellent quality and are of size appropriate to that of the pages.

Nuttall's Manual was for a long time the only text-book of American ornithology available to pockets of limited resources. Its style and treatment of the subject are most attractive, and it has probably done more to diffuse a knowledge of the subject than any other work. Boys read it who had access to no other, and many naturalists of to-day date their interest in their science to the charm of its pages. Although the excellent works of Coues and Ridgway have made us better acquainted with the science of ornithology, nothing has superseded Nuttall's work as a delineator of habits and manners of birds. It was a happy thought that resulted in the publication of this new edition under Mr. Chamberlain's editorship.

---

[2] A Popular Hand-book of the Ornithology of the United States and Canada, based on Nuttall's Manual. By Montague Chamberlain. Boston: Little, Brown & Co., 1891.

Seeley on the Fossil Reptiles: II. Pareiasaurus; VI. The Anomodontia and their Allies; VII. Further Observations on Pariasaurus.[3]—Professor H. G. Seeley has again made the scientific world his debtors by his descriptions of new forms of South African fossil reptiles; by his extensive comparisons of the characters of these, the oldest known members of the class; and by his very full study of that remarkable form, the Pariasaurus of Owen. These works are valuable to students of the Reptilia of corresponding age in other parts of the world, and especially to those of the American forms. The descriptions are elucidated by cuts and plates.

Prof. Seeley has shown that the genus Pareisaurus is allied to the American Diadectidæ, and that it represents a distinct family of the same order, the Cotylosauria. His proposition of a new ordinal name, Pariasauria, is perhaps due to the fact that the original definition of the Cotylosauria was defective in one respect. The corrected definition was published later, and in the same year as the proposal of the new name by Dr. Seeley.

Several important points of both anatomy and taxonomy are presented in these memoirs, on which I propose to touch. In the first place, no one had, at the time that these memoirs were written, distinguished between roof-bones and the bones of the brain case, in the Reptilia. Although the two series are to be entirely distinguished in all vertebrates which possess them, the same names have been used variously for opposite or adjacent elements of both. The names squamosal, epiotic and opisthotic have thus been used in double senses. For the posterior bones of the temporal roof I have adopted the terms zygomatic, supratemporal, supramastoid[4] and tabulare.[5] The supratemporal is called squâmosal by Seeley. But the squamosal is a bone of the lateral wall of the brain case, and cannot be identified with any one of the three possible post-orbital bars of the Reptilia, which may be composed posteriorly of either the zygomatic, supratemporal or supramastoid. The epiotic of Seely and of some others is the tabulare m., and has nothing to do with the original epiotic of Huxley.

Prof. Seeley describes the Placodontia as possessing two occipital condyles, which have the position of zygapophysial articulations. The basioccipital he describes as presenting "a thin film of bone" posteriorly on the middle line. Perhaps the basioccipital bone with its con-

---

[3] From the Philosoph. Transac. Royal Society of London, 1888, p. 59; 1889, p. 215, and 1892, p. 311. Illustrated.

[4] Transac. Amer. Philosoph. Soc., 1892, 11.

[5] Proceeds. Amer. Philosoph. Soc., 1894, 110.

dyle is caducous, as it is in the Diadectidæ, and has been lost from the specimens Dr. Seely has examined. It is this peculiarity that led me into error in my first diagnosis of the Cotylosauria.

Prof. Seeley makes quite full comparisons with the forms of the American Permian. He seems impressed with reptilian affinities in Eryops. But this genus is a true Stegocephal in every respect, and has no greater affinity with the Cotylosauria than any other member of the order. In quoting my description of the tarsus of the Clepsydropidæ, he falls into error in stating that I allege that "the tibials and centrals united to form an astragalus." I have stated that the intermedium and centrals unite to form the astragalus. He also states that I have not figured the intercentra of the Pelycosauria. He will find that my figures of Clepsydrops and Dimetrodon represent them.

Dr. Seeley shows that the structure of the vertebral column and pelvic arch have a close similarity in the Cotylosauria, Anomodontia and Theriodonta of South Africa. I have discovered the same characters of these regions in the Cotylosauria and Pelycosauria of North America. For the order which is to include these divisions, Seeley, like Lydekker, retains the name of Anomodontia of Owen. But Owen originally proposed this name for the group which includes the genera Oudenodon, Dicynodon and Lystrosaurus (Ptychognathus Owen). Further, in his work of 1876[6] on these reptiles, he continued this use of the name, making it of equal rank with the Theriodonta. It being evident that the entire division required a name, I gave it that of Theromorpha (Proceed. Amer. Philosoph. Soc., 1880, p. 38); (subsequently altered to Theromora, on account of preoccupation.) The use of the name Anomodontia for this order has no support in the rules of nomenclature.

Dr. Seeley discusses the possible relation of the Pelycosauria of the American beds with the African Theriodonta. There are important resemblances between these groups. Unfortunately, corresponding parts of the two are in several cases unknown. Thus the shoulder girdle and tarsus of the Theriodonta have not been yet obtained. Until these lacunæ are made good we cannot determine the mutual affinities of the two. We naturally look to Prof. Seeley for more light on this subject. It is possible, also, as I have suggested, that the postorbital arch of the Theriodonta is the superior arch (supratemporal), and not the inferior arch (zygomatic), as in the Pelycosauria.

NOTE.—In my paper on the Plesiosaurian skull (Proceeds. Amer. Philos. Soc., 1894, p. 111, line 10), by a lapsus calami, I wrote Proterosauria for

---

[6] Description of the Fossil Reptilia of South Africa in the British Museum.

Procolophonina. In my paper on the postorbital bars of Reptilia (Trans. Amer. Philos. Soc., 1892, p. 16, bottom) I refer to the postorbital bar of the Theriodonta, meaning the Pelycosauria. This is due to the premature assumption by English authors, to which I at the moment assented, that the two groups are identical.—E. D. COPE.

Scott on the Mammalia of the Deep River Beds.[7]—In this handsome memoir of 130 pages we have recorded the results of the Princeton College expedition of 1891. The region explored is the valley of Deep River, one of the upper tributaries of the Missouri in Montana. This formation was observed to contain fossils by Grinnell and Dana in 1875, and was explored by a party sent by the present reviewer in 1878. The latter reported from it twelve species of Mammalia all of which were new except a Prothippus of Loup Fork age, and a Protolabis of uncertain species. The Princeton expedition obtained twenty-two species, of which eight are new to science. Prof. Scott prefers to call this formation by the name of Deep River, rather than the Ticholeptus bed, as it was originally named by Cope. This is because the name Ticholeptus, as a paleontological term, is a synonym of Merychyus. However, as applied to a formation, it was not preoccupied, and it is doubtful whether, under the rules, it can be changed.

The new forms belong to the following orders: Carnivora, 2; Glires, 1; Perissodactyla, 2. Artiodactyla, 3. The most important addition to the Carnivora is a new genus of Canidæ, Desmatocyon, which agrees with Canis, except in the possession of three longitudinal convolutions of the cerebral hemispheres. The Glires are represented by a new Steneofiber. The most important novelties are two species of three-toed horses, which are named respectively *Desmatippus crenidens* and *Anchitherium equinum*, the latter the largest known American species of its genus. Prof. Scott takes occasion to present a new classification of the genera of American three-toed horses, distinguishing four genera in species formerly referred to Anchitherium. These are Mesohippus, Miohippus, Desmatippus (nov.) and Anchitherium. Scott has already shown that Mesohippus differs from the other genera in the absence of pits of the incisors, and he assumes that Miohippus, named but not distinguished by Marsh, possesees those pits, although he states that its upper incisors are not known. I can state that this supposition is perfectly correct, as they are present in the species I have called *Anchi-*

---

[7] From the Transactions of the American Philosophicel Society, 1894, Vol. XVII, p. 55.

therium equiceps, *A. longicriste* and *A. praestans*, from the John Day Beds of Oregon, the horizon of Miohippus. The separation of Miohippus from Anchitherium is proposed by Prof. Scott, on the relative size of the conules of the molars, on the form of the external face of their external wall, and on the separation or confluence of the posterior transverse crest with the latter. The first two characters do not appear to me to be of generic value, while the third is probably a valid one. On this basis the John Day *Anchitheria equiceps*, *brachylophum*, and *longicriste* must be referred to Miohippus, while *A. praestans* is an Anchitherium. That is, supposing Marsh's type of Miohippus possess the character referred to, which is unknown. The same character will refer Desmathippus to Anchitherium; and the other characters regarded by Prof. Scott as distinguishing the two, do not seem to the reviewer to be of sufficient value to forbid such reference.

The *Anchitherium crenidens* (as we would call it) presents especial interest in the strong crenation of the anterior border of the metaconule, offering the earliest example of this structure known, and pointing to the origin of the similar structure seen in later horses of several genera. In the *A. equinum* we have the American form nearest to the European *A. aurelianeuse*. The American (White River) *A. exoletum* Cope (not *A. cuneatum*, as stated by Scott) has superior molars of similar character.

In the Artiodactyla, the most important discovery is the presence of an ossified thyroid cartilage, and a probable rudimental clavicle in an Oreodontid, which but for these characters would be an Eporeodon. To this form Prof. Scott gives the name of Mesoreodon.

We expect thorough and intelligent work from Prof. Scott, and in this memoir we are not disappointed. It is by papers of this kind that our knowledge of the evolution of organic life is really advanced. The illustrations are every way worthy of the text.—E. D. Cope.

Von Ihring on the Fishes and Mammals of Rio Grande do Sul.[8]—These two brochures are valuable as bringing the subject of which they treat up to a later date than the papers of Hensel, who wrote in 1870–2–9. The species are not all described, and some of the notices embrace descriptions of habits, while the known distribution is given, with pretty full references to the literature. The species of

---

[8] Die Süsswasser Fische von Rio Grande do Sul; von Dr. H. von Ihring, 12mo, 36 pp.; Rio Grande, Jan. 1893.

Os Mammiferos do Rio Grande do Sol, pelo Dr. Herman von Ihring, 12mo, pp. 30; Rio Grande, Apl. 20, 1892.

fishes enumerated are chiefly those of the Atlantic streams. They are included in the following orders: Nematognathi, 23 sp.; Plectospondyli, 14 sp.; Holostomi, 1 sp.; Percomorphi, 8. A new Gobius is described. The Mammalia number 92 species, of which 11 are Marsupialia, 5 Edentata, 23 Glires, 16 Chiroptera, 20 Carnivora, 17 Diplarthra, 3 Quadrumana, and 2 Cetacea. An interesting feature is the number of species of Didelphyidae, of which a new species is described. The author includes without hesitation the *Felis braccata* Cope in the *F. jaguarondi*, probably because in the original description it is said to be allied to that species. As matter of fact, however, it is very little allied to that species, and has no close relationships to any other. It is remarkable for the large size and pointed outline of its ears, which are sharply bicolor on the upper surface. The mounted skin shows faint oblique bands on the sides. Its very obscure colors render it easy of concealment, which, perhaps, with its apparent rarity, accounts for its having so long escaped the observation of naturalists. Von Ihring also asserts the identity of the *Sphingurus sericeus* with the *S. villosus*. If the latter is, as generally asserted, identical with the *S. insidiosus*, the *S. sericeus* is distinct enough.—E. D. COPE.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Geologic Time indicated by the Sedimentary Rocks of North America.—Various geologists have speculated as to the age of the earth, basing their estimates on both geologic and paleontologic data. The latest contribution to the subject is from Dr. Charles Walcott. His unit is the age of the Paleozoic rocks of the Cordilleran area in western North America. A careful consideration of all the factors of denudation and deposition leads him to consider that it would have required 17,500,000 years for the deposition of the calcium and the mechanical sediments of Paleozoic time. He concludes his paper as follows:

"Taking as a basis 17,500,000 years for Paleozoic time, and the time ratios 12, 5 and 2 for Paleozoic, Mesozoic and Cenozoic (including Plistocene) respectively, the Mesozoic is given a time duration of 7,240,000 years, the Cenozoic of 2,900,000 years, and the entire series of fossiliferous sedimentary rocks of 27,650,000 years. To this there is to be added the entire period in which all of the sediments were deposited between the basal crystalline archean complex and the base of the Paleozoic. Notwithstanding the immense accumulation of mechanical sediments in this Algonkian time, with their great unconformities and the great differentiation of life at the beginning of Paleozoic time, I am not willing, with our present information, to assign a greater period than that of the Paleozoic—or 17,500,000 years. Even this seems excessive. Adding to it the time period of the fossiliferous sedimentary rocks, the result is 45,150,000 years for post-Archean time. Of the duration of Archean or pre-Algonkian time, I have no estimate based on a study of Archean strata to offer. If we assume Houghton's estimate of 33 per cent. for the Azoic period and 67 per cent. for the sedimentary rocks, Archean time would be represented by the period of 22,250,000 years.

"In estimating for the Archean, Houghton included a large series of strata that are now placed in the Algonkian of the Proterozoic of the U. S. Geol. Survey; and I think that his estimate is more than one-half too large; if so, ten million years would be a fair estimate, or rather conjecture, for Archean time.

Period.	Time Duration.
Cenozoic, including Pleistocene	2,900,000 years.
Mesozoic, ...	7,240,000 ".
Paleozoic, ...	17,500,000 "
Algonkian, ...	17,500,000 "
Archean, ...	10,000,000(?) "

"It is easy to vary these results by assuming different values for area and rate of denudation, the rate of deposition of carbonate of lime, etc.; but there remains, after each attempt I have made that was based on any reliable facts of thickness, extent and character of strata, a result that does not pass below 25,000,000 to 30,000,000 as a minimim and 60,000,000 to 70,000,000 as a maximum for post-Archean geologic time. I have not referred to the rate of development of life, as that is virtually controlled by conditions of environment."

"In conclusion, geologic time is of great but not of indefinite duration. I believe that it can be measured by tens of millions, but not by single millions or hundreds of millions of years." (Journ. Geol., Vol. I, 1893.)

For the latest estimates as to the duration of the Glacial period see AMERICAN NATURALIST, March, 1894, p. 263.

The Lignites of Southern Chili.—After having made a field study of the lignitic formation in the southern part of Chili, M. Noguès reports to the Société Scientifique of Chili that these lignites certainly do not belong to the Permo-carboniferous age, as has been stated, but are of a much later age. They constitute a long band extending in a north and south direction, parallel with the Pacific Ocean, and have been dislocated by a complex series of faults. M. Noguès extended his observations to the schisto-arenaceous system, which is found around the river Bio-Bio and its affluents, La Quilacoya and the Rio Grande, and which contains beds of true anthracite coal. Paleontological evidence shows that this system corresponds with the lower beds of the lignitic formation above mentioned. Like the lignite, also, it rests unconformably upon granite rocks and the old schists of the Cordilleras, and been subjected to movements which have produced folds, swellings and anticlinals. (Actes de la Soc. Sci. du Chili, Santiago, 1894.)

Lower Cretaceous Fossils from the Black Hills of Dakota.—A recent find of cycadean trunks near Hot Springs, South Dakota, led Mr. Lester Ward to investigate that locality with the view

of determining the stratigraphical position of the beds in which the fossils occur. The whole of this region consists of a series of sandstones that have been treated in the Black Hills report as the "Dakota Group." In examining a locality two miles west of Minnekahta Creek, Mr. Ward found, interstratified with the sandstones, some argillaceous shales containing a fossil flora of ferns, coniferous twigs and cycadean remains, which the author refers to the Lower Cretaceous. A further study of the plants by Prof. Fontaine and Prof. Knowlton confirms this reference. Between the horizon where these fossils were found and that of the true Dakota Group there are some hundreds of feet of sandstone and shales. (Journ. Geol., Vol. II, 1894.)

Lower Eocene Mammals near Lyons, France.—A preliminary note published by M. Charles Deperet in Comptes Rendus, April, 1894, states that a remarkably rich deposit of Eocene Vertebrates has been discovered in a quarry at Lissien, near Lyon. The author proposes to make these fossils the subject of a special memoir, but meanwhile, he gives the following brief summary of the most important facts:

"The [Perissodactyla] are the most numerous. At the head of the list stands Lophiodon, represented by three forms: one, having molars of the type named by M. Rütimeyer, *L. rhinoceroides*, but the body not quite so large. A second species resembles in form *L. isselense*, but is distinguished by its inferior premolors which have the cingulum very attenuated, recalling in this particular *L. cuvieri* of Jouey. The third form has a large premolar furnished with a rudimentary internal posterior cusp, as in *L. lautricense.*

"The American genus Hyrachyus is represented by a type that I believe to be identical with *Lophiodon cartieri* Egerkingen, and also a species of Argenton, named by M. Filhol *Hyrachyus intermedius.*

"The group [Lophiodontidae] is still more abundant. I can only mention two Paloplotheria, one large (*P. magnum* Rütimeyer), the other hardly larger than *P. codiciense* Gaud. to which it is evidently related, from the structure of the premolars.

"The genus Propalaeotherium is represented by two species, one large, indentical with *P. isselanum* Cuv.; the other small, suggesting *P. minutum* Egerkingen. A small Anchilopus seems to be related to *A. desmarestii* Gerv. Finally, there are some inferior molars which correspond to those of the ill-defined genus Lophiotherium Gerv.

"Among the Artiodactyla I have noticed the molars of *Acotherulum saturninum* Gerv., and one fine demi-mandible of a Dichobune smaller than *D. leporinum.*

"Of the group of primitive ruminants, there are only some molar teeth which seem to be identical with *Dichodon cartierii* Egerkingen.

"But the most interesting discovery among the Ungulates is a single upper molar, differing only by its smaller size from that of the animal of Egerkingen, referred by Rütimeyer to the American genus Phenacodus, under the name *P. europæus.*

"The Carnivora are represented by several types, among others a Pterodon, a primitive Viverra, with the heel of the sectorial tooth very short, as in *V. angustidens.*

"Finally, of the group of rodents, there is a fine demi-mandible of a Sciuroides, related to *Sc. siderolithicus* of Egerkingen.

"Among the undetermined species are some bones of Birds and Reptiles."

Geological News, Paleozoic.—According to Mr. C. Schuchert, a collection of fossils, comprising about thirty species, most of which are corals, demonstrate the undoubted presence of middle Devonian deposits in northern California. All the fossils studied are from limestone, nothing as yet being known from a sandstone or shale fauna.

The localities in which these collections were obtained have been examined by Mr. J. S. Diller. They are in Shasta and Siskiyou counties, California, and as the general strike of Devonian rocks near Kennett is in a line with outcrops of Hazel Creek and Soda Creek, over thirty miles away, it is thought that these rocks may be continuous. This would be an additional evidence for Mr. Diller's theory previously stated "that the axis of folding joins the Klamath Mountains to the Coast Range rather than to the Sierra." (Am. Journ. Sci., June, 1894.)

Dr. Ludwig von Ammon has published a memoir on the Stegocephali of the Rhein-pfalz known to him. These include nine species which are referred to the following genera: Branchiosaurus, 2; Apateon, 1; Anthracosaurus, 1 sp.; Archegosaurus, 2 sp.; Sclerocephalus, 2 sp.; Macromerium, n. g. von Ammon, 1 sp. The most abundant remains belong to Sclerocephalus, which includes also the the largest species. *Macromerium gumbelii* von Amm. was also a large species. The memoir (published at Munich) is in 4to, and is handsomely illustrated.

Dr. Hermann Credner published in the XXth Volume of the Abhandlungen of the Royal Saxon Society of Science a beautifully illustrated memoir on the histology of the teeth of the Paleozoic Stegocephali with plicate dentition. The investigation is confined to the

genus Sclerocephalus. By removal of the osseous structure, Credner obtains beautiful casts of the vascular structures of the teeth. From this study Dr. Credner concludes that the large teeth of the Stegocephali are formed by the fusion of small teeth, such as are frequently present on the palatine and splenial bones of these animals.

Mesozoic.—The eastern boundary of the Connecticut Triassic is defined, according to Messrs. Davis and Griswold, by fault-lines—a combination of several intersecting faults, rather than a single irregular fault. The inferred faults may be divided into two sets, those of one set trending about north and south, and represented by three members; those of the other set trending northeast and northwest, and including two members. All five faults are believed to extend beyond the parts of the border line that they determine into the area of the crystalline or Triassic rocks. (Bull. Geol. Soc. Ann., Vol. V, 1894.)

In a paper in the Journal of the Philadelphia Academy, Prof. Cope describes several Pycnodont fishes from the Wichita Cretaceous bed of western Oklahoma, and a Lepidotid from the Trinity formation of Texas. He also describes part of a tarsometatarse of a bird from a probable neocene bed of Vancouver Island, under the name of *Cyphornis magnus.* He thinks it is allied to the Pelicans, but the bone is as large as the corresponding part of the American Ostrich.

A collection of Neocomian invertebrates from Kansas yields upon examination 17 new and 4 rare species. Among them is a large, apparently nereid, worm, and a well-preserved specimen of *Trochus texanus* Roem. The fossils are described and figured by Prof. F. W. Cragin in the Am. Geol., Vol. XIV, 1894. Prof. Cragin also reports from the same formation two new reptiles, *Pleisiosaurus mudgei* and *Plesiochelys belviderensis;* and three fishes hitherto undescribed, *Mesodon abrasus,* (*? Lamna*) *quinquilateralis* and *Hybodus clarkensis.* (Fifth Ann. Pub. Col. Sci. Soc., 1894.)

Cenozoic.—In the fourth part of the "Materiaux pour l'Histoire des Temps Quaternaires," MM. Gaudry and Boule describe bones of Mammalia from the caves of Gorgas in the Hautes Pyrenées. They found there *Ursus spelaeus, Crocuta maculata spelaea,* and *Canis lupus.* They embrace the opportunity of showing the graduated dentition of the Canidae from Canis through Hemicyon and Hyaenarctus, of which they give instructive figures.

M. Harlé calls attention to the discovery of fossil Hyaenas of the striped type, in the grotto of Montsaunés (Haute-Garonne). With the exception of a specimen found in the grotto of Lunel-Viel by Marcel, at the beginning of this century, there is no record of this Hyaena having ever been found in a cave in France. (Comptes-Rendus, Paris, 1894.)

Professor Dames, of Berlin, describes some remains of a Zeuglodon from Fayoum in Egypt in the Paleontological Abhandlungen for 1894. They consist of a left mandibular ramus and vertebrae of a species of medium size, which he regards as belonging to a species previously unknown. He calls it *Z. osiris*. He makes some suggestions as to the systematic of the Cetacea, proposing to divide the order primarily on the characters of the teeth. This view will not, however, probably replace the customary one, which regards as of more importance the skeletal characters of the Archæroceti, and relegates the dentition to a place of secondary value.

Dr. G. Capellini had added much to our knowledge of the extinct Cetacea of Italy in a number of illustrated papers. He describes several species of Ziphius and Mesoplodon, some of which are new; a Delphinoid with a long muzzle; a Tursiops; and the *Balæna etrusca* Cap. He also describes the remains of a new Halitherium (Metaxytherium), and a crocodile with a slender muzzle, which he refers to the genus Tomistoma, under the name of *T. calaritanum* Cap. The latter is represented by a fine skull, and some vertebræ and dermal scuta, and other important pieces.

PETROGRAPY.[1]

In a long and extensive article, Mügge[2] treats of the keratophyres of the Lennethal in Westphalia, and the neighboring regions, and their tuffs. The rocks have been considered as fragmental schists by some observers and as squeezed eruptives by others. They are known generally as the Lenneporphyries. Mügge finds that some of them are genuine eruptives and some are the tuffs of these. The massive rocks are keratophyres and quartz-keratophyres, sometimes carrying large phenocrysts of quartz and feldspar and at other times free from these. The groundmass of the keratophyres is made up of bleached biotite, sericite, feldspar, opal and glass, with traces of spherulitic structure. Schistose varieties of the quartzose varieties have become foliated through pressure, as shown by the fractured quartzes and feldspars that occur so abundantly in them, the presence of lenticular areas of quartz mosaic and the greater abundance of sericite. The most characteristic of the lenneporphyries are tuffs in which the ash structure is very well exhibit. The typical tuff structure is described by the author as due to the accumulation of glass particles with concave boundaries. These are mingled with complete and broken crystals of various minerals and often with sedimentary material. Rocks composed of intermingled volcanic and sedimentary fragmental material the author would call tuffites; when metamorphosed, tuffoids. Many of the rocks in the Lenne district have suffered dynamic metamorphism with the production of secondary quartz, feldspar, sericite, carbonates and chlorite. They are, therefore, tuffoids. The new material was formed partially from the decomposition of the rock's materials and partially with the aid of alkaline solutions originating outside of the metamorphised rocks.

Nepheline-Melilite Rocks of Texas.—Osann[3] finds a melilite nepheline basalt occurring as dykes in the Cretaceous of Uvalde Co., Texas, and nepheline basanites forming buttes and hills in the same region. The basalts are typical melilite varieties, containing phenocrysts of olivine and micro-porphyritic crystals of melilite with all the characteristic features of this mineral. Perofskite is a common

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville. Me.

[2] Neues Jahrb. f. Min., etc. B. B. viii, p. 525.

[3] Jour. Geol., Vol. I, p. 341.

accompaniment of the melilite. The basanites have an andesitic habit and since they contain more or less sanidine, they approach phonolite in composition. Hornblendes, two monoclinic augites and nepheline are common as phenocrysts, while sanidine, plagioclase and olivine are scarce. The rock of Pilot Knob, near Austin, is a porphyritic nepheline basalt.

Eleolite Syenite from Eastern Ontario.—Adams,[4] while making a geological reconnaissance in the township of Dungannon, Ontario, discovered a large area of eleolite syenite in the Laurentian of the region. The rock is notable especially for the fresh scapolite and calcite present in it and for the fact that its feldspathic constituent is an albite. Petrographically the syenite is an aggregate of the minerals above mentioned and hornblende, biotite, sodalite, garnet and zircon. The nepheline is fresh. It occurs in large quantity, and sometimes in individuals two and a half feet in length. Its composition according to Harrington is

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Loss	Total
43.51	33.78	.15	.16	tr	5.40	16.94	.40 =	100.34

The mica is a dark yellow-brown variety. It is present in small quantities only. Hornblende is also comparatively rare. It occurs in two varieties in different specimens. One variety has a large optical angle and a pleochroism of deep green and pale yellow tints. The other is allied to arfvedsonite. It has a small axial angle, and is pleochroic in deep bluish-green and yellowish-green tints. The scapolite is in large colorless grains that are fresh and seem to be original, and the calcite in more or less rounded individuals, often included within the other constituents. The feldspar is largely albite. A small quanitity orothoclase occurs, especially associated with the sodalite. This orothoclase is thought to be secondary.[5] An analysis of the sodalite gave:

SiO_2	Al_2O_3	FeO	Na_2O	K_2O	Cl	SO_3	H_2O	Ins.	Total
36.58	31.05	.20	24.81	.79	6.88	.12	.27	.80 =	101.50

O = Cl 1.55 = 99.95.

Petrographical News.—The basic dyke material at Hamburg, Sussex Co., N. J., which was thought to be leucite tephrite by Hus-

[4] Amer. Jour. Sci., 1894, XLVIII, p. 10.

[5] Cf. also Geol. Surv. of Can., Vol. VI, Pt. J.

sak[6] and declared by Kemp[7] to be an aggregate of pyroxene, biotite and analcite has been examined at another place by the last named geologist. It has been found by him[8] to contain leucite. Hussak's determination is thus confirmed. The rock is a leucite tephrite.

A spherical granite from a boulder discovered on Qonochontogue Beach in Southwestern Rhode Island is described by Kemp[9] as a coarse granitite, with nodules from two to three inches in diameter scattered through it. These consist of a center of coarse plagioclase with a little quartz, surrounded by a concentric zone of biotite and magnetite, and a peripheral one of radiating plagioclase, whose laths end sharply against the granite matrix. The author explains the nodules as centers of crystallization.

The rocks that have for the past few years been called muscovadite by the Minnesota Geological Survey have recently been examined by Grant,[10] who finds among them several distinct rock types. Some of muscovadites are fine grained aggregates of pyroxene, quartz and feldspar, containing in their midst large flakes of biotite. Others are composed of quartz and biotite, etc. These are considered as contact rocks. A second class of the muscovadite comprises granulitic gabbros and norites.

The siliceous oolite of State College, Pa., is composed of radial spherules of fibrous chalcedony forming bands around fragments and rounded grains of quartz. Between the spherules are bundles of chalcedony fibres placed normal to the surface of the spherules nearest them, and intermingled with these are granular chalcedony and quartz. An oolite from the Tertiary beds of New Jersey is an aggregate of sphero-crystals of chalcedony, usually without nuclei. Occasionally a cone of fine grained quartz is to be seen, but this is rare. The matrix between the spherules is partly chalcedony and partly quartz.[11]

Duparc and Mrazec[12] refer very briefly to the mineralogical composition of an occurrence of Serpentine at Geisspfad in the Swiss Alps. The rock now contains hornblende, chromiferous diopside, diallage and some secondary substances in addition to serpentine. The rock was probably originally a Lherzolite.

---

[6] Amer. Naturalist, 1893, p. 274.
[7] Ib. 1893, p. 563.
[8] Amer. Jour. Sci , XLVII, 1894, p. 333.
[9] Trans. N. Y. Acad. Sci., XIII, 1894, p. 140.
[10] 21st Ann. Rep. Minn. Survey, p. 147.
[11] E. O. Hovey: Bull. Geol. Soc. Amer., Vol. 5, p. 627.
[12] Bull. Soc. Franc d. Min., XVI, p. 210.

Phillips[13] has analyzed specimens of Pele's hair (I) and of lava stalagmites (II) from the caves of Kilauea, Hawaii, with these results:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	P_2O_5	CaO	MgO	Na_2O	K_2O	Total
50.76	14.75	2.89	9.85	.41	.26	11.05	6.54	2.70	.88	= 100.09
51.77	15.66	8.46	6.54	.82		9.56	4.95	2.17	.96	= 100.89

Lacroix[14] finds specimens of nepheline basalt from Saint Sandoux, Puy-de-Dom, France, in an old collection preserved in the College of France.

Some of the trap dykes of the Lake Champlain region are camptonites. Others consist of monchiquite, fourchite or bostonite. All are described by Kemp and Marsters[15] in a recent Bulletin of the Survey

---

[13] Amer. Jour. Sci., XLVII, p. 473.

[14] Bull. Soc. Franc d. Min., XVII, p. 43.

[15] Bull. U. S. Geol. Surv., No. 107.

BOTANY.[1]

Notes on a Few Shrubs of Northern Nebraska.—Of 50 shrubs that grow in the northern tier of counties west of Antelope County, some few have interested the writer and may prove of general interest. The observations extend over a period of six years. They are likely to be continued with equal profit in the years to come. The order followed is that of Professor Bessey's "Native Trees and Shrubs of Nebraska."

The only shrub representing the Coniferae is *Juniperus communis* L. I have seen it only in Hat Creek Basin, Sioux County. There it grows in prostrate ascending form, exactly like the juniper of Connecticut, in dry pastures. I have no specimen of the latter, but suppose it to be var. *alpina.*

Corylus americana Walt. is chiefly remarkable for its absence in this region. I have found it only in Cherry County, ten miles east of Valentine and 20 miles southwest on the Niobrara and its tributaries. It is flourishing and abundant where it occurs. Its lack of distribution may be partly accounted for by the late frosts of this high altitude (2600 ft.), which, as this year, destroy the flowers.

Salix tristis Ait. is very common over the sand-hill portion of Cherry County, also in Brown and Holt Counties. When it was sent to Mr. M. S. Bebb from Long Pine, Brown County, he stated that that was its western limit, so far as he knew. It is probable that Cherry County furnishes the limit sixty miles further west. Gray's Manual gives the height "1–1½ ft. high." It grows 5 feet high at Long Pine, in the brush.

Salix cordata is represented by var. *angustata* Anders., though the State claims var. *vestita* Anders. in the other portions. Mr. Bebb (Coulter's Man.) says: "It is altogether incredible, however, that any form of *S. cordata* ever attains tree-like size." I have a specimen at Ewing, Holt County, about twenty feet high and eight inches in diameter—a pretty sizable shrub! I shall measure it and take specimens this season. I will state, however, that it retains its shrubby character by branching ten or fifteen times just above this diameter, some of the branches being five or six inches through.

---

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska,

Rhus toxicodendron L. As an instance of adaptability to environment, this species is noteworthy. It is very common on the sandy prairie of this region, perfectly upright, seldom over one foot high, with no tendency to creep, fruiting freely. Even in the brush you will seldom see it as a climber. It deserves more attention than most collectors would care to give it.

The wild crab is represented in these counties by *Pyrus ioensis* (Wood) Bailey. It has been commonly called, heretofore, *P. coronaria* L., but is much too white-wooly. It forms large patches covering several acres in extent, and, when not browsed by cattle, produces useful fruit. Its western range, so far, is northern Brown County.

Crataegus coccinea L. also represents the family with its beautiful scarlet clusters of edible fruit. While stray trees have been found in Cherry County, probably coming south from Rosebud Agency, where it is said to be common, I have not found it common west of Holt County.

Amorpha microphylla Pursh. is a new shrub in Nebraska. I found it last year (1893) on the gumbo hills of Holt and Boyd Counties, very common, but quite confined to that soil. It was reported also from another section of the State.

Up to the present time, no species of *Oenothera* has been reported as shrubby so far as my reading extends. I have seen indications in past years that caused me to suspect *Oenothera serrulata* Nutt of having the character, to some extent. This year, I have abundant confirmaion. Here at Valentine. after a dry, hard winter that has killed whole timber claims of forest trees by freezing dry, a plant of this species has bloomed vigorously on shoots six inches long, starting from last year's stock five to six inches above the ground. The situation was fully exposed to all the rigors of the season. I have found several other plants sprouting vigorously two and three inches above ground. It shows about the same degree of hardiness as half the plants of *Amorpha canescens* Nutt., and quite as much as *Gutierrezia euthamiae* Torr. & Gray in this climate, both of which have long been classed as shrubs.

Valentine, Neb. —J. M. BATES.

Botany at Brooklyn.—The recent scientific meetings in Brooklyn brought out a good number of botanists, whose papers and discussions touched upon nearly all parts of the subject of Botany, from Bacteriology to Paleobotany. That all were of a high order of merit could not be truthfully affirmed, but that all were creditable, and some of unusual interest is true. The botanists of the country have no rea-

son for feeling ashamed of their work as represented in these meetings.

In the Society for the Promotion of Agricultural Science nearly every paper dealt with some question more or less botanical. Here of course, the treatment was economic rather than strictly scientific, and yet in every case there was much of interest to the botanist. Thus there were papers on "The Vitality of the Seeds of Red Clover" (*Beal*); "The Russian Thistle in Nebraska" (*Bessey*); "A possible Relation between Blights and Exceptional Weather" (*Halsted*); "The Growth of Lettuce as affected by Physical Properties of the Soil" (*Galloway*); etc., etc.

The Botanical Club of the Association held several interesting sessions, and took active part in a delightful excursion by boat to Cold Spring Harbor on the north shore of Long Island. Among the notes presented before the club were the following: "The Prothallium of *Marsilia vestita*" (*Bessey*); "Notes on Oat-Smut" (*Jones*); "The use of Formalin as a Preservative Agent" (*Galloway*); "Sporangial trichomes on Ferns" (*Durand*); "The Significance of Stipules from the standpoint of Paleobotany" (*Hollick*); "A Plea for the better Pronunciation of Botanical Names" (*Bessey*); "A Species of *Olpidium* parasitic on *Spirogyra*" (*Durand*); "A method of making pure cultures of Fungi" (*Smith*); etc., etc.

A Committee on the pronunciation of Botanical Names was appointed consisting of Charles E. Bessey, N. L. Britton and E. L. Greene. The officers for the next year are Douglas H. Campbell, of Palo Alto, California, and Frederick C. Newcomb, of Ann Arbor, Michigan.

Twenty-six papers were read before Section G, beginning with the opening address by Vice-President Underwood, upon "The Evolution of the Hepaticæ." In this the speaker traced in a masterly way the evolution of the several groups of the liverworts, pointing out their mutual relationships, as well as their affinities with higher and lower plants.

The other papers were as follows:

B. T. Galloway, "The Growth of Radishes as affected by the Size and Weight of the Seed"; Katherine E. Golden, "The Movement of Gases in Rhizomes"; A. D. Hopkins, "Some Interesting Conditions in Wood resulting from the attacks of Insects and Woodpeckers"; W. J. Beal, "The Sugar Maples of Central Michigan"; John M. Coulter, "Some Affinities among Cactaceæ"; Charles E. Bessey, "Simplification and Degeneration"; Frederick C. Newcomb, "Regu-

latory Growth of Mechanical Tissue"; Charles E. Bessey, "Further Studies of the Relationship and Arrangement of the Flowering Plants"; Erwin F. Smith, "The Watermelon Disease of the South"; L. H. Bailey, "The Relation of Age of Type to Variability"; L. H. Bailey, "The Struggle for Existence under Cultivation"; "George F. Atkinson, "Relation between the Functions of the Vegetative and Reproductive Leaves of *Onoclea*"; H. H. Rusby, "*Lophopappus*, a new genus of Mutisiaceous Compositæ and *Fluckigeria*, a new genus of *Gesneriaceæ*"; George F. Atkinson, "On the Swarmspores of *Pythium* and *Ceratiomyxa*"; Elizabeth G. Britton, "A Revision of the genus *Scouleria*"; B. G. Wilder, "Evidence as to the former existence of large trees on Nantucket Island"; N. L. Britton, "Notes on Primary Foliage and the Leaf-scars in *Pinus rigida*"; Byron D. Halsted, "Notes upon *Chalara paradoxa*"; Elizabeth G. Britton, "A Hybrid among the Mosses"; Byron D. Halsted, "Notes upon a Root-rot of Beets"; N. L. Britton, "On *Torreya* as a Generic Name"; Elizabeth G. Britton, "Some Notes on the genus *Encalypta*"; Jed. Hotchkiss, "The Growth of Forest-trees illustrated from marked corners 107 years old"; Mrs. F. W. Patterson, "Species of *Taphrina* parasitic upon Populus"; Albert Mann, "Products of Metamorphosis and Monstrosities" (by title only).

Reports of progress were made by several of the Committees appointed last year, and they were continued for further work.

The Committee of the charter members of the Botanical Society of America held several meetings persuant to a call of the Chairman, Dr. Trelease, and perfected the organization of the Society. Much time was spent in discussing the details of the organization, and in perfecting plans for work. The officers for the ensuing year are as follows: President, William Trelease, St. Louis; Vice-President, N. L. Britton, New York; Secretary, Charles R. Barnes, Madison, Wis.; Treasurer, John D. Smith, Baltimore.

Provision was made for a meeting sometime during the summer of 1895, the time and place to be announced later by the Executive Committee.

CHARLES E. BESSEY.

ZOOLOGY.

On the Vertical Distribution of Pelagic Crustacea in Green Lake, Wisconsin.—Green Lake is the deepest body of water in the State of Wisconsin, having a maximum depth of about 60 meters. Because of its great depth it has not only the litoral and pelagic faunæ of the shallower bodies of water, but also the true abyssal fauna which is characteristic of the deeper lakes. In fact, the crustacean fauna of Green Lake is almost identical with that of the great lakes.

In the deeper waters of Green Lake are found fifteen species of crustacea. Of these, twelve may be fairly considered as belonging peculiarly to the deep water fauna. Most of these can be captured in very large numbers at night by means of the skimming net. During the day, very few are found at the surface, some few never come to the surface, and are only obtained by dredging in the deep water.

Of course, an open dredge, dropped from the surface to the bottom and then hauled up, will collect from all depths. After a little experience, the collector has no difficulty in distinguishing between pelagic and abyssal species, and can even draw inferences, with a reasonable degree of accuracy, in regard to the general vertical distribution of species. So far as I know, however, very little exact work has been done to determine the vertical limits of the various species. By means of dredges which could be closed at any required depth, it has been found that in the deep sea there is a surface fauna and a deepwater fauna, but that the immediate intermediate region is barren of animal life. According to Agassiz, the surface fauna extends to the depth of 200 fathoms, and the bottom fauna is limited to about 60 fathoms.

Is there a similar condition in the waters of our lakes? With a view to answering this question, I made some preliminary collections in the summer of 1893.

I used, for the collections, a vertical dredge, so constructed that it could be closed at any desired depth. The collections upon which this paper is based were made in the latter part of August, at all hours between five o'clock in the morning and nine o'clock at night. Each series included collections for every five meters in depth. Of course, until a much larger number of collections is made, and at different seasons of the year, no final conclusions can be drawn. But the results

thus far are interesting, and I think later collections are not likely to modify, to any great extent, the conclusions I have formed.

The results were a little disappointing to me at first, I must confess. I had made up my mind that I should find the three regions characteristic of the deep sea—the pelagic, intermediate and abyssal. It was rather discouraging, then, when I found material in my dredge from all depths. Not only that, but when I began to examine the collections under the microscope, I found certain species, which I had considered peculiar to the surface—like *Diaptomus minutus*—occurring all the way from the surface to the mud of the bottom. The barren intermediate zone, then, does not exist in Green Lake. It is true, however, that the numbers of individuals are less at intermediate depths than near the surface or near the bottom, and that some species are vastly more numerous in the upper zone, while others are almost entirely confined to the lower.

I counted the number of individuals in each haul, and after reducing the numbers to percentages, tabulated the results.

I will give briefly the conclusions I reached in regard to those species which are found most commonly.

The species which is found in the greatest numbers is *Diaptomus minutus*. In one haul this was associated with *D. sicilis* (a somewhat rare form in Green Lake), and in my computation I did not separate the two, as their habits are identical. On the average, 46 per cent of this species is within five meters of the surface, and 59.4 per cent within ten meters. Within ten meters of the bottom are only 7.37 per cent. It is evident that more than one-half of the individuals of these species are found within ten meters of the surface, and that from that point to the bottom, the numbers steadily decrease.

Daphnella is more exclusively pelagic—79 per cent being found within ten meters of the surface, and only 5.6 per cent at the bottom.

Epischura is still more distinctly pelagic—81 per cent being in the first ten meters, and 3.3 per cent in the last ten.

Leptodora, *Bosmina* and *Cyclops fluviatilis* are also found much more abundantly near the surface. *Leptodora* rarely goes below fifteen meters.

Daphnia kahlbergiensis seems somewhat erratic in its distribution. On the average, nearly 43 per cent are found within the first ten meters, but nearly 25 per cent are found in the last ten. Generally speaking, they appear more numerous near the surface and the bottom, but less so at intermediate depths. But they may occur at all depths, and sometimes quite numerously in the intermediate region.

Limnocalanus macrurus rarely, if ever, comes to the surface, and is found most abundantly within 20 meters of the bottom. Nordqvist states that he found *L. macrurus* in Finland, in June, most abundant at twelve meters below the surface, where the total depth was 25 to 26 meters.

Pontoporeia and *Mysis* live at the bottom, and belong to the true abyssal fauna.

In regard to the diurnal migrations of the pelagic species, I found it difficult to fix any exact limits. As has been before stated, they come to the surface at night. In the daytime, few of them go below ten meters. *Daphnia kahlbergiensis*, however, seems to be an exception, for, apparently, its migrations are limited only by the depth of the lake, and sometimes from 40 to 80 per cent are in the last ten meters.

As a result of these collections, I was led to doubt the value of "Plankton" determinations, at least so far as crustacea are concerned. All such determinations must start with the assumption that the life of the deeper waters is distributed uniformly. If this were true, successive hauls in the same depth of water would contain approximately the same number of individuals. This was far from the case in my collections. The position in the successive collections varied only as the boat drifted very slowly; yet the number of *Diaptomi* varied from 291 to 2,966; *Daphnella* from 0 to 122; *Daphnia kahlbergiensis* from 6 to 103, and *Epischura* from 7 to 105. It seems probable that they are present in swarms, and that the positions of the swarms are continually changing.

Zacharias, in his last report from the biological Station at Plön, has reached the same conclusions, not only in regard to the crustacea, but also the other pelagic organisms. "Plankton" determinations, in order to have much value, must be almost infinite in number.

Beginning with the fall of 1894, systematic work of a more detailed character will be carried on at Green Lake, as the Trustees of Ripon College have made an appropriation for the purpose.

—C. Dwight Marsh, Ripon College, Wisconsin.

Rotatoria of the Great Lakes.—The Michigan Fish Commission have issued, as Bulletin No. 3, a list of the Rotatoria found in Lake St. Clair and some of the inland lakes of Michigan, prepared by Mr. H. S. Jennings. Of the 122 rotifers named in the list, 6 are here described and figured for the first time. Strongly swimming forms, commonly found in the open water, are designated pelagic; those found among the vegetation of the shores and bottom, littoral. Of the former,

20 were observed in Lake St. Clair. In the case of the inland lakes, collections were made from the shore only. The most abundant pelagic species are *Polyarthra platyptera* Ehrbg., *Anuraea cochlearis* Gosse, and *Asplanchna priodonta* Gosse, which agree, in this respect, with the condition found in European lakes.

The Internal Anatomy and Relationship of Pauropus.—According to Peter Schmidt, whose preliminary paper appeared in the *Zoologischer Anzeiger*,[1] the internal anatomy of *Pauropus* allies it most closely with *Polyxenus* among the Diplopoda. The absence of trachea, of malpighian tubes and of a circulatory system, together with the presence of a rather complicated genital apparatus in the male, seem to show that it is very degenerate. That it belongs along with the Diplopoda—a fact that has been questioned—the presence of the ovary below the intestine, of the genital openings in the third body segment behind the second pair of legs, and of only two pairs of oval appendages, abundantly testify. The biramose antennæ may possibly be explained by a comparison with the sense papillæ at the end of the terminal joint of the Diplopod antenna, the more readily, too, since, according to Schmidt, the distal portions of the rami, the geisseln of Latzel appear to be finely ringed and not segmented.

Several peculiarities are interesting. The mid-gut is without a *muscularis* and its epithelial cells are filled with rhomboid crystals with double refractive powers. The supra- and sub-œsophageal and the first body ganglia are fused into one mass which is pierced by a very short fore-gut. The small processes on the first segment represent rudimentary legs and possibly function in respiration like the abdominal sacs of Thysanura, Symphyla and certain Diplopods. The sense organ of the antennæ, the *globulus* of Latzel, consists of an outer and inner capsule with the intervening space filled with a fluid. The whole is surrounded by ten or twelve bristles while the nerve passes into the inner capsule and expands into a nail-like head. (Fig: 1.)

Fig. 1.

The female genital apparatus consists of an unpaired ovary lying, beneath the intestine, an unpaired receptaculum seminis and an oviduct opening to the exterior by an unpaired opening to the one side of the median line in the third segment. In the male there is an unpaired testis above the intestine, a complicated pair of ducts, a pair of seminal

---

[1] Zur Kenntniss des inneren Baues des Pauropus huxleyi Lubb. Zool. Anz., XVII, 189.

glands, and a pair of genital openings. Near the middle the testis communicates with the two small vasa deferentia that open into two large tubes which are bent upon themselves. These open posteriorly into two ducts that run forward beneath the intestine. The anterior half of each of them is double. In the fourth segment they unite into a short tube on the side of the body. This communicates with a transverse tube into which the seminal vesicles open, and which opens to the exterior by two openings.

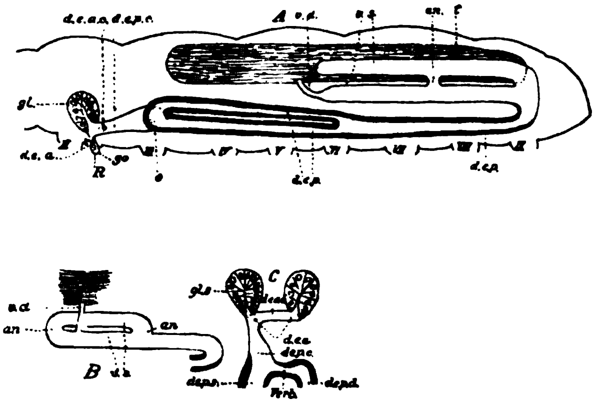


Fig. 2.

Diagrammatic representation of the male genital organs of *Pauropus huxleyi* Lubb. A. From the left side, II–IX the coxæ of the II–IX pairs of legs; t, testis; v.d, *vas deferens;* v.s., *vesiculæ seminales;* an, anastomosis; d.e.p., *Ductus ejaculatorius posterior;* o, opening between the d.e.p.; d.e.p.c., *Duct. ejac. post. communis;* d.e.a.c., *Duct. ejac. anterior communis;* gl., *glandula accessoria;* d.e.a., *Duct. ejac. anterior;* go, genital opening; R, penis.

B. From the right, somewhat shortened.

C. The anterior part from above.

The spermatozoa are pod-like. —F. C. KENYON.

Thysanura from the Cave of Central France.—M. R. Moniez describes three new species of Thysanoures from the grotto of Dargilan in the Department of Lozére, France. The first, *Campodea dargilani,* appears to be the third of a series of forms adapted progressively for a life in darkness. That is, the characters of *C. staphylinus,* the type of the genus living in open air, are more accentuated in *C. coopei,* a cave form, and are carried to an extreme in *C. dargilani.* The second, *Sira cavernarum,* is white, covered with transparent scales, and is entirely blind. The third, *Lipura cirrigera,* is characterized by

tufts of 6 or 7 cirrhi at the base of the second joint of the attennæ. These cirrhi are spaced at their insertion and recurved. These organs are present in the other Lipurae, but in so rudimentary a state that they have heretofore escaped observation. (Revue Biol. de Nord., Dec., 1893).

Result of a Comparison of Antipodal Faunas.—Prof. Gill's paper on a comparison of the piscine fauna of the British island with that of the New Zealand waters contains some important deductions. An analysis of a tabulated list of the families of these two regions shows that twenty-five families are represented in the New Zealand seas and not in the British; of these eleven are peculiar to the Southern Hemisphere; four are represented in the Northern Pacific, but not in the North Atlantic; and ten, although not represented in the British seas, have quite a general distribution.

Of the fresh-water species, those characteristic of the Northern Hemisphere are, with the exception of the Argentinidae, entirely unrepresented in the Southern, while the Antipodal types are wanting in the Northern zones.

According to Professor Hutton, the New Zealand Fishes belong to no less than six distinct geographical realms: Notalian, Antarctalian, Pelagalian, Bassalian, Tropicalian and Ornithogæan. A consideration of these various elements and comparison of them with those of other regions leads Dr. Gill to the following conclusions:

"The main marine fauna of New Zealand is derived from representatives of the general stock which has become developed in the great Notalian realm. The number of species apparently peculiar to the province, and, therefore, modified from other or earlier representatives, indicates a long period of isolation in accordance with its distance from the nearest continents and the depth of the intervening ocean. The percentage of such peculiar species seems to entitle it to rank as a distinct region (or subregion) rather than as an integral portion of the Notalian region composed of the isothermal portions of Australia and Tasmania, as has been generally done. A more extended study and actual comparison of the species of the two regions may, however, compel a reconsideration of this view."

"The fresh-water fishes must have been derived from the same common source as those of the isothermal portions of Australia (of course, including Tasmania) and South America. There may not have been a continuity of land at any one time between South America, Australia and New Zealand, but, at more remote period in the past, it is, at

least, possible that there was a region in which the Galaxiids and Haplochitonids were developed, and subsequently representatives of those families might have found their way into the regions where they now abound."

In the discussion of the possibilities of the origin of the present types of the fresh-water fishes of New Zealand, it appears that Dr. Gill is of the opinion that "community in type must be the expression of community of origin, and the presence of fishes of long-established fresh-water types must imply continuity or at least contiguity of the lands in the midst of which they occur at some time or other." He then adds: "We may be permitted to postulate (fishes being congeneric in New Zealand, Australia and South America), that there existed some terrestrial passageway between the several regions at a time as late as the close of the Mesozoic period. The evidence of such a connection afforded by congeneric fishes is fortified by analogous representatives among insects, mollusks, and even amphibians. The separation of the several areas must, however, have occurred little later than the early Tertiary, inasmuch as the salt-water fishes of corresponding isotherms found along the coasts of the now widely separated lands are to such a large extent specifically different. In general, change seems to take place more rapidly among marine animals than fresh-water representatives of the same class." (Fifth Mém., Vol. VI, Natl. Acad. Sciences.)

The Carotid, Thymus, and Thyroid Glands form the subject of a rather lengthy paper by A. Prenant.[1] He had a good series of embryos, and studied carefully the histological changes during development. According to him the carotid gland originates from the third entodermal branchial pouch, and at first becomes closely connected with the primitive carotid artery, but later loses this connection and becomes united with the head of the thymus. In regard to the lymphoid transformation of the thymus, he says that in embryos, from 25 and 85 mm. in length, there appear small nuclear elements among the primitive epithelial cells, which stain deeply and are comparable to lymphocytes. The thymus in embryos of 85 mm. and upwards begins to differentiate itself into an outer cortical portion and an inner medulary portion. The latter is clearer, looser in texture and poorer in lympathic elements than the cortical portions. This further becomes differentiated into a peripheral and an inner portion. The former stains less, is richer in karyokinetic figures than the latter. It

[1] Contribution à l'etude de développement organique et histologique des Thymus de la glande thyroid, et de la glande carotidienne. A. Prenant, La Cellule, X.

is doubtless a germ of proliferation. Nothing surrounding the organ authorizes the supposition that this is a muscular connective tissue which produces the lymphocytes that fill the organ. It is probable that epithelial cells after multiplying actively by mitosis, give rise to the lymphocytes by simple division (stenose). For large nuclei with small buds frequently occur and small nuclear bodies may be seen by the side of large nuclei and within the same. This mode of division is more common in the earlier stages. In older embryos the lymphocytes are formed karyokinetically. The epithelial cells that probably persist even in the completely developed organ he compares with the cells forming the matrix of the testis and the coveys of lymphocytes arising from them with the seminal elements.

The lateral portions of the thyroid develop from the fourth entodermal branchial pouch, which is forked. From the angle of this there grows up an organ that in structure and appearance is comparable with the carotid gland. This he calls the *glande thyroidienne.* It finally comes to lie outside of the vascular-connective hilum of the thyroid. During development an anfractuous cavity appears in the thyroid and is prolonged in every direction by deep diverticula. At first its walls are stratified and then simple. The superficial cells disappear after a transformation comparable to that which occurs in the internal assizes of the epithelium of the æsophagus. The wall produces around itself a cellular reticulate structure of dense aspect, which later disappears. Whether the lateral gland gives rise to buds that become confusingly anastomosed and eventually transformed into thyroid vesicles, or whether the lobes of the median gland solder themselves to the tissue of the lateral gland, it is impossible to say.

There is very little of a comparative nature in the paper beyond an attempt to introduce a formula to represent the number and position of the glands in invertebrata. This is not nearly as readily understood as a simple diagramatic figure; moreover, it is entirely unnecessary.

Of possible interest in connection with the work of Prenant is a short paper by J. Beard on the Development and Probable Function of the Thymus.[3] In Raja he declares that the epithelial nature and appearance of the cells composing the gland is lost very soon after their formation. Their nuclei stain intensely, and the cell-body, i. e., the protoplasm, is very scant from the start. It is clear that there is no inwandering of lymph cells, but that these elements are the direct offspring of the epithelium of the gill cleft.

[3] Anat. Anz., IX, p. 476.

As to the function of the gland, bearing in mind the observations of Stöhr and Killian on the tonsils, he concludes that the thymus exists in fishes for the protection of the gills from bacteria, etc., by the formation of leucocytes. With the disappearance of the gills of fishes and perrennibranchiate amphibians, the gland undergoes a restriction in the area of its formation and its functions are transformed to other organs. In the higher vertebrates this protective function is transferred to the tonsils at the opening of the respiratory passage.

—F. C. Kenyon.

ENTOMOLOGY.[1]

On the larvæ and pupæ of Hololepta and Pyrochroa.—Aside from those of direct economic importance, the larvæ of North American Coleoptera have received too little attention from entomologists, and many of our common beetles are quite unknown in their early stages, while others have received passing notice in text-books or agricultural reports, with here and there a figure, and sometimes a few words of description, more or less vague. Many of the injurious ones have been, however, investigated in the most thorough manner by our best students of insect life.

The two species treated of in the present paper have not before been given space in our literature beyond, in one case, a short note. It has, therefore, been thought fit to furnish detailed descriptions and figures for the use of those who may wish to indentify specimens in their possession.

HOLOLEPTA FOSSULARIS Say. Plate XXVI, figs. 1, a, b, c, d.

Color of larva nearly white, head chestnut, prothorax with a triangular space, occupying most of the upper surface, a little lighter than the head. Back with a dark line for the greater portion of the length where the viscera show through.

Form elongate, somewhat flattened; length 17.5 mm.

Head castaneous, quadrate, broader than long; above strongly flattened, with four impressed lines on the front and an impressed space near the base of each antenna, from which a line of punctures runs to the base. Anterior margin produced, truncate in front, and with a lobe over each mandible. Beneath, less flattened, with a broad, deep impressed space on the gular region, extending in the form of a narrow groove to the base.

Antennæ arising from the sides of the head, immediately behind the base of the mandibles, four-jointed, the first joint very short, sunken, the second long, the third shorter, subtriangular, with three papillæ at end, fourth joint again shorter, elongate oval. There are, apparently, no bristles, except two short and inconspicuous ones at the tip of the last joint.

Eyes are, apparently, altogether wanting.

---

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

Mandibles stout, rather long, curved, with a strong, rounded tooth before the middle.

Maxillæ composed of a long, stout basal piece, heavily bristled, especially on the inside, a shorter second joint, which bears a one-jointed appendix, tipped by a bristle, on the outside; third, fourth and fifth joints subequal, the last two, however, a trifle longer and more slender.

Mentum borne on a tuberculiform base, elongate, wider near the tip, palpi two-jointed terminal joint longer.

Prothorax corneous, transverse, sides and base somewhat rounded, apex nearly truncate, median line distinct, rather deep, a deeper impression each side external to which is a vague foveate impression. Beneath with two deeply impressed lines strongly convergent anteriorly, posterior to which are two foveæ.

Meso- and metathorax much shorter than the prothorax, membranous with a long, crescentic, horny scute at middle, both above and below, and smaller ones at sides. Each of these segments bears a lateral bristle.

Abdomen of nine segments, which are protuberant near the middle of the sides and transversely wrinkled, armed with two lateral and one ventro-lateral bristle on each side. Each segment except the last is granulato-spinose on the scutes of the under surface; the last bears two bi-articulate appendages, each armed with five bristles, as shown in the figure. The anus is inferior.

Spiracles in nine pairs, the first situated beneath the anterior mesothoracic angles, the others in segments 1 to 8 of the abdomen, near the anterior margins and somewhat ventro-laterally.

Legs small, weak, slender. The coxæ are rounded, imperfectly chitinized, the trochanter distinctly marked, femur somewhat creased on the edges, tibiæ shorter, slightly bristled, claw single with two short bristles at about the middle of the length.

The pupa is white, 10 mm. in length and of the same general shape as the beetle, but with a more pointed abdomen; the meso-metasternal area is coarsely punctured.

Nearly full-grown larvæ of this species were found under the bark of an old cottonwood log near the end of March, between the thin layers next to the wood. In captivity they fed upon the pupæ of Diptera taken in the same situation. After several days the largest one constructed a case of small pieces of bark; the dimensions were 14 by 7 mm., the outside rough, but the inside perfectly smooth. In this case the change to a pupa took place after a rest of above a week.

PYROCHROA FLABELATA Fabr. Plate XXVI, figs. 2, a, b, c, d, e, f.

Color of full-grown larva clear, light yellow, the head, especially the mouth parts, and the terminal processes castaneous.

Form elongate, much depressed, sides sub-parallel, slightly broader behind, segments with dorso- and ventro-lateral bristles. Terminal segment corneous with two stout processes directed upward and backward. Length 34.5 mm.

Head corneous, free, the sides strongly rounded, front produced at middle, labrum distinct, tip sinuate more prominent at middle, anterior margin strongly bristled, suture very slightly sinuate. Top of head with a depressed space surrounding a large tubercle, anteriorly with transverse striations and two tolerably distinct longitudinal lines.

Eyes consist of four ocelli on each side of the head, just posterior to the antennæ. The three anterior ones in each group are arranged in a slightly oblique curved line, back of the middle of which the fourth is placed.

Antennæ lateral, situated behind the base of the mandibles, four-jointed, the first joint stout, short, the second long, third and fourth subequal, together somewhat longer than the second. The fourth joint is much more slender than the third, and all are strongly bristled.

Mandibles extremely stout and heavy, deep, the tip emarginate, internally strongly toothed, as shown by the drawing.

Maxillæ large, strong corneous; the lobe is sinuate on the inner margin and armed with bristles, those near the end arrayed in rows, the inner apical ones recurved. The palpi are stout, the second and third joints about equal and separately longer than the first; all are bristly.

Mentum of the form shown in fig. 2 f. The shaded portion is thicker and more perfectly chitinized than the remainder, and has every appearance of being divided by sutures from the underlying and superimposed pieces.

Prothorax about equal in width to the head, the sides nearly straight, except at the angles, where they are abruptly directed inwards. Median line distinct with a fovea each side anterior to the middle and crossed in front of these by a fine transverse line. Beneath with two strongly impressed lines which, originating between the coxæ, diverge strongly in front and attain the margin near the anterior angles, the triangular space thus enclosed being also bistriate at middle.

Mesothorax broadest near the base, more convex than the prothorax, with distinct median line, and, on each side of this, a vague double fovea,

slightly behind the middle. Anteriorly there is a fine transverse line crossing the median one at right angles. Beneath is a smooth subquadrate space, usually bounded at sides and behind (except for a short distance at middle) by broad, deeply impressed lines.

Metathorax similar, but the lines beneath effect a junction at the middle.

Abdomen with the first seven segments quite similar in form, subangulate at the sides, median dorsal and anterior transverse lines distinct, the former more so. Beneath is a very well marked submarginal plica. The eighth segment is larger, longer, more perfectly chitinized, sides slightly rounded. Median dorsal line very distinct, with a less distinct oblique one on each side. Beneath there is an impressed median line which has posteriorly a slightly elevated carina on each side; external to this is a sinuous broader line each side, and outside of this again a very deep impression which extends from a point distant about one-fifth from the basal lateral margin to the posterior angle of the segment. The anal segment is small, carinate, more distinctly at base, visible only from beneath, being overlaid by a corneous plate bearing two spinose and granulate processes. Viewed from above the space between these processes is somewhat semicircular in outline, and the two *cul-de-sacs* between them are distinctly visible. From beneath the processes look almost straight and the *cul-de-sacs* do not appear. The accompanying figure will give a much better idea of this complicated structure than a description can convey.

Spiracles in nine pairs, the first situated in the mesothorax under the anterior angles, the rest abdominal. The pair on the first abdominal segment is dorso-lateral, the next lateral, and the remainder (in segments 3 to 8) are ventro-lateral; all except the last pair, which are behind the middle, are placed nearer the anterior than the posterior margin of the segment.

Legs stout, coxæ not very prominent, femora strong, broader at tip and compressed within, tibial pieces subcylindrical, claws single, long, curved, with an indistinct blunt tooth and a bristle near the base. The suture between the femur and trochanter is well marked, and these as well as the tibiæ are rather sparsely bristled.

Larvæ of the above mentioned species were taken at Iowa City on the 13th of April from beneath the bark of a rotting elm log. On the 7th of May one of them changed to an elongate white pupa, 16 mm. in length, which had the power of moving very rapidly about on its back, tail foremost. It was very sensitive, a slight touch on any of

the bristles sufficing to set it in motion. The beetle appeared on May 16th.

In a short note on page 76 of the third volume of PSYCHE, Mr. H. L. Moody has given us a means of distinguishing the larvæ of four of the species of the family Pyrochroidæ that he has raised. The larva of *Schizotus cervicalis* he says is of a smoky tint, while the remaining three (mentioned hereafter) are yellow; of these, *Dendroides canadensis* has long, slender, curved processes nearly one-third longer than the basal portion, and the *cul-de-sacs* not visible from above; *D. concolor* has stouter, nearly straight processes hardly longer than the basal portion, and the tips are obliquely cut off on the inner side, while the *cul-de-sacs* are just visible (by the projecting lower margin) from above. In *Pyrochroa flabellata* the processes are nearly straight on the inner edge when viewed from below, and short, strongly dentate; the *cul-de-sacs* are very large, plainly visible from above. I notice that the length of the processes is subject to some little variation, but no doubt these characters will hold good in general.

EXPLANATION OF PLATE.

Fig. 1. *Hololepta fossularis* Say, larva; *a*, pupa; *b*, mouth and antenna from below; *c*, anterior leg; *d*, caudal appendix.

Fig. 2. *Pyrochroa flabellata* Fabr., larva; *a*, pupa; *b*, antenna; *c*, mandible; *d*, terminal portion of abdomen from below; *e*, maxilla; *f*, mentum.

H. F. WICKHAM, Iowa City, Iowa.

ARCHEOLOGY AND ETHNOLOGY.[1]

Gailenreuth Cave in 1894.—Dr. Zittel says (Beiträge zur Anthropologie und Urgeschichte Baierns ii, p. 226) that the remarkable discoveries in the English and French caves about 1875, caused the comparatively recent exploration, notably by Dr. Fraas (about 1877), of caverns in the limestone valleys of the upper tributaries of the Main (in the Franconian Switzerland, Bavaria) and along the northern confluents of the Danube (in Würtemberg). But, as he explains, J. F. Esper (Ausführliche Nachricht von neuentdeckten Zoolithen, 1774), had scientifically examined several of the Wiesent Valley caves (in Franconia) more than a hundred years before, and, as far as is known, had anticipated all investigators—even the Rev. McEnery, the long-neglected explorer of Kent's Hole—in the discovery of human remains associated with the bones of extinct Plistocene mammals.

The cave map of Bavaria (Beiträge zur Urgesch. Bai. 2, plate 14) is thickly dotted with the red signs for caverns in the mill region north of the right Danube bank between Ulm and Ratisbon, here and there in the Alpine valleys of the Iller, Isar and Saal far to the southward, but thickest of all along the upper Main Valley by the Wiesent, Ailsbach and Püttbach tributaries, about a spot twenty miles to the southwest of Bayreuth. Here it was, in the hill-top cave, one-quarter of a mile from the Castle Gailenreuth (left bank of Wiesent, two miles above Muggendorf), that Esper's most important work was done. The entombed bones of legendary Dragons and Unicorns, the extraordinary teeth exhumed during the Middle Ages to be ground into medical nostrums, had not yet been rearranged into the now well-known shapes of Mammoth, Cave Bear, Hyena and Rhinoceros. Human prehistoric work in stone was unrecognized, and the existence of River Drift and Cave Men was unsuspected, when at Gailenreuth, on finding a human jaw with three teeth and a shoulder-blade in a layer of "Antediluvian" bones, Esper made the memorable observation:

"Since they (the human remains) lay under the animal bones with which the Gailenreuth Cave was filled; since they were found in what, in all probability, was their original layer, I infer, not without adequate ground, that these human relics were of like age with the animal remains above them."

This remarkable inference, in 1774, making Gailenreuth classic ground for the cave explorer, was carried no farther by Esper. Nor

---

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

did it impress Buckland who, though he visited the cave in 1816, and carried a skull afterwards found (now in the Oxford Museum) to England, seems to have regarded with indifference the similar observations of McEnery at Kent's Hole. No further cave exploration was undertaken in the Franconian region until 1878.

The Gailenreuth Cave or "Zoolithenhöhle" enters the top of a gentle hill separated from the brink of the widest gorge (about 290 feet deep) by a level plateau. Cold and wet as I found it, in August, 1894, and accessible from the stream only after a steep climb, with an entrance (now walled up) invisible from the valley, and not at all conspicuous from the plateau above, the remote forest-hidden cavern, like Hartman's Cave in Pennsylvania, had the look rather of an animal den than a possible habitation for primitive savages.

Esper found its two spacious chambers as now level-floored with the entrance and ending in two or more chasms 20 feet deep by 6 to 10 feet in diameter in the rear. His description makes it uncertain whether he dug his trenches at the bottom of the chasms or on the chamber floors, how deep he went, and whether he reached rock bottom. In his search for bones the following points were noted:

(1) *The pottery.*—The whole cave floor (chambers and chasms) was covered with a bed of charcoal, above which rested a layer of potsherds. These he divided into four kinds: (a) rude hand made of red brick clay mixed with coarse sand; (b) of rude, sandy clay, with fragments of quartz; (c) of finely worked potters' clay, smoked dark and glazed outside and in; and (d) of carefully worked, fine red potters' clay.

Repeating the notion of cremation of bodies, he supposed that the potsherds were the remains of the urns in which food had been placed near sacred fires built by Huns or Wends to the spirits of their kinsfolk 800 to 1000 years before.

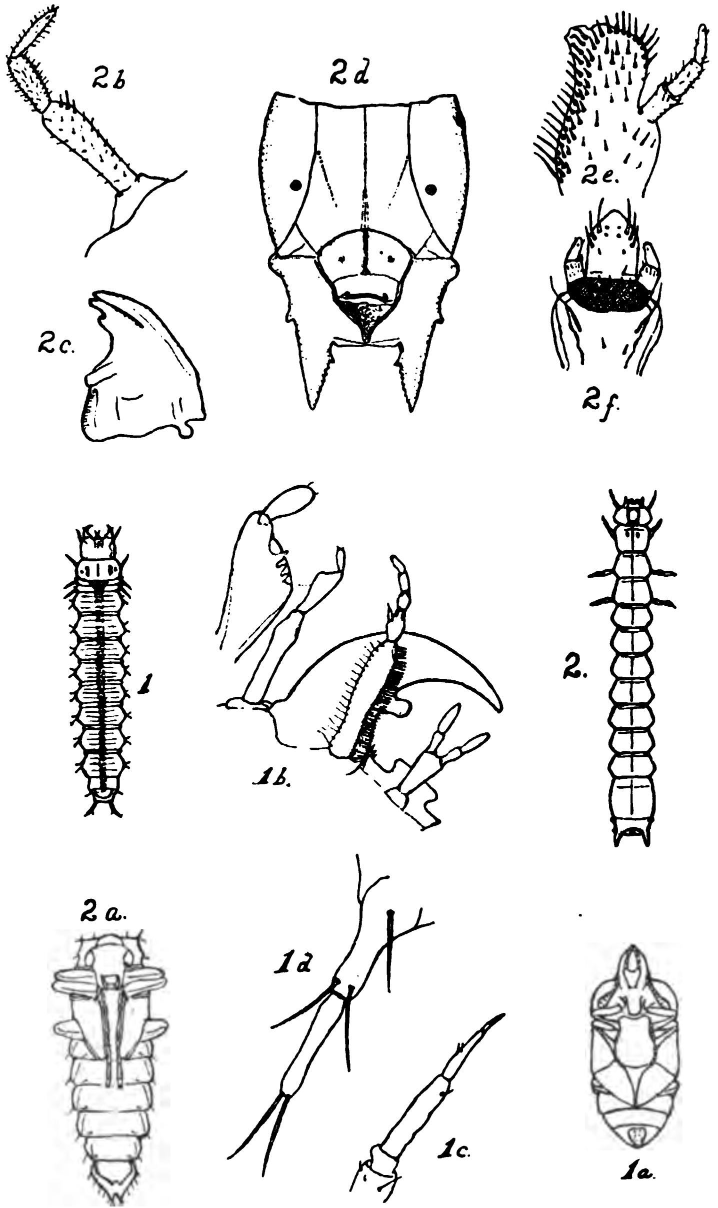
This pottery is still abundant. I scratched out several pieces in the disturbed earth at the bottom of one of the chasms. Esper says that it does not occur at a greater depth than three feet.

(2) *The immense number of animal bones*—The fauna afterward identified, given by Ranke, consisted of Mammoth, Giant Elk, Reindeer, Cave Bear (dominant), Gray Bear, Brown Bear, Cave Lion, Cave Hyena, Woolly Rhinoceros,[1] Wolf, Fox, Beaver, Glutton, Cave Rat and Ground Squirrel. The bones lay in confusion at the bottom of the chasms and in a thick bed under the potsherds on the chamber

---

[1] Ranke (Beiträge 2, p. 196), quoting Dawkins, does not mention Woolly Rhinoceros, Glutton (*Gulo spelaea*), Beaver, *Arvicola spelaea*, and Squirrel, but I found them labelled from Gailenreuth in the Schloss Museum at Bayreuth.

PLATE XXVI.



Hololepta and Pyrochroa.

floors, and how they got there has remained a puzzle to the present day. I found the gnawed fore-leg bone of *Ursus spelaeus* at the bottom of one of the chasms, but the Carnivora or men could not have brought in the fossils, since none, it seems, have been mentioned as split for the marrow and very few gnawed.

If water washed them in (and this has seemed likely from the pebbles found mixed with them), then we must imagine a valley nearly the size of the Niagara Gorge, as yet uneroded, with the Wiesent somehow sweeping into the cave the bones and not the carcasses of animals that had perished along its shores.

Animals often go into caves to die, but Esper urges they could not have done so in this case, as he found no skeletons entire. He suggests an immense flood driving them to the cave for refuge, where, being drowned, their remains were washed about and broken by surging waters. But, after fairly stating the objections to this and other theories, he gives up the problem in despair.

Esper based his notion of the immense number of animals represented, not on the fragments found, but upon a white, chalky layer of decomposed bones, which he does not describe as continuous, discovered by him in several parts of the cavern. If we give this up as a test of quantity, we have only left for a witness of the often alleged prodigious number of individuals in Gailenreuth, the thickly scattered fragments from 3 to 6 inches long, and in the proportion of about 15 to a half bushel of earth, which I saw on scratching with a hoe, at the bottom of the chasms.

Spite of all the bone hunting done in the cave, there are probably as many of these pieces (which no collector would want) as ever. And if it is fair to guess at the ratio of bones to earth from them, and from the odds and ends set in the growing stalagmite of the walls, the number of entombed animals, though great, was not extravagantly so.

(3) *The human bones.*—The jaw and shoulder blade Esper found at a depth, not exactly stated, of several feet under an extending ledge of rock at a point not since identified. They were bedded in a layer one foot thick of fossils mixed with pebbles, which underlaid the white chalky stratum of decomposed bones above-noted, and have been, unfortunately, lost. I found no description of the position of the skull mentioned by Ranke as afterwards found in the cave, and taken to England by Buckland.

Potsherds, according to Esper, were found at depths of three feet, and without more conclusive evidence, it must remain doubtful whether in this case the human bones were not intrusive and to be referred to a later time than that of the fossil animals.

In the bottom of one of the chasms, which had evidently been disturbed by previous digging to a considerable depth, my scratching brought to light two teeth, a lower jaw and leg bone of *Ursus spelaeus*. The wet stalagmitic walls of the rift were scantily bedded with bone fragments, and I saw many pieces set in loose fragments of breccia which recent fossil hunters had gouged out of the walls and found not worth taking away. No doubt crusts of stalagmite projecting here and there from the walls over the cave earth had been broken through, but I saw no signs of previously-existing floors of large extent in the chasm.

Here, where some loose bones steeped in carbonate of lime were hard as stone, while others projected from the drip looked comparatively fresh,[3] the value of breccia, of fossilization, and of stalagmitic crusts covering underplaced layers as tests of age seemed small. Still more was I inclined to reject such criteria when, a few days later, I was shown stalactites 60 centimeters long produced in fifteen years on the reservoir roof at Bayreuth, and when Professor Adami, of Bayreuth, told me that he had seen, in 1884, stalactites in a tunnel between Zelfenkasten and Conters (in Switzerland) 6 inches long and forty years old. It was soon apparent that a great deal of digging had been done in the cave. No doubt the searchers for "Unicorns horns" had been there before Esper. Doubtless "Neuhaus Hans" of recent local fame had found profit in the contents of down-reaching fissures. But, in spite of the frequent overturning of mould and breccia, it might not be impossible still to demonstrate the meaning of the layers at Gailenreuth. The bottoms of the chasms have probably, owing to the cramped space, never been reached, and several places may well exist in the upper chamber floors that have not been disturbed at all. However that may be, Gailenreuth, the starting point of modern cave exploration, shows well the bearings and the difficulties of real work done in caverns, and suggests many of the puzzles which still perplex the investigator.

H. C. MERCER.

---

[3] Like the Cave Bear and Lion skulls in the Schloss Museum at Bayreuth.

MICROSCOPY.[1]

Notes on Gold Impregnation Technique.—The following method of using formic acid and gold chloride is a modification, or adaptation of a method used by Miss Julia B. Platt and kindly suggested by her to me. She refers it to Professor Mark of Harvard University. I have used it in tracing the nervous system of *Nephelis lateralis* and have found it reliable. In leech tissues, it differentiates all nerve tissue, though the histology of other tissues is poor. After more than a year's use of this method without a complete failure among my preparations, I feel that Lee's characterization of the other methods of gold staining does not apply to this method.

It has been used successfully on larval vertebrate material as well as on leech tissue, by varying the strength of the formic acid, or the time of its application. The other factors are to a great extent indifferent as to strength used or time employed. If maceration occurs, lessen the action of the formic by weakening or by shortening the time. If the impregnation is slight, increase the action. The thickness of the piece stained should not exceed 5 mm., and the tissue must be living.

The following is the process employed with *Nephelis:*

The leech is put into twenty or thirty times its bulk of 10% formic acid and left from 3 to 5 minutes. It dies well extended. Transfer without washing to 1% Gold chloride (of commerce) for 25 minutes; then without washing into 1% formic acid for 24 hours, or until reduction is complete. This is indicated by a rich purple color over the whole specimen. Wash slightly in tap water; run up through the alcohols to chloroform; to chloroform saturated with hard paraffine. My sections are usually cut 16μ thick. When the impregnation appears to be very light—almost a failure, stain the sections on the slide with erythrosin or some other deep red anilin stain for contrast. These sections will often show the most exquisite details.

Transparent larvæ 5 to 10 mm. long require a milder treatment, such as the following: 5% formic acid 2 or 3 minutes, 1% or ½% gold chloride 10 minutes, weak formic 1 to 4 hours. If the specimens are watched from time to time under the dissecting lens, it will be seen that the central nervous system stains first and then the peripheral. The reduction of the gold chloride may be stopped, of course, at any point by transferring to alcohol.

---

[1] Edited by C. O. Whitman, University of Chicago.

All the operations described above were conducted in diffuse daylight and the gold chloride solution was exposed to sunlight for some time before using. This may not be an essential factor to the process, but Dr. L. Lindsay Johnson, in the third edition of Lee's *Vade Mecum*, suggests that failure to ripen the solution by sunning may be the cause of many of the failures in gold staining.

C. L. Bristol.

University of Chicago, April 14, 1894.

Gold Chloride–Formic Acid Staining of Sections after Fixation in Sublimate Alcohol.—S. Apathy in the the Zeitschrift für Wissenschaftliche Mikroskopie. Bd. X, 1893, p. 348.

The following method is extracted from an article on the muscle fibres of Ascaris.

Take equal parts of a saturated solution of corrosive sublimate in a ½ per cent solution of common salt and absolute alcohol; or dissolve 3 per cent of corrosive sublimate and ½ per cent common salt in 50 per cent alcohol. Use the liquid boiling hot for Ascaris, cold for leeches, and leave the animals in it for 24 hours, or at least 12 hours. Wash out in 50 percent alcohol until the mahogany-brown color of an iodine-alcohol solution remains unchanged for a few days. Free the tissues from iodine in 90 per cent alcohol. Imbed in paraffin, using chloroform for the transferring medium, and fix the sections on the slide. Free them completely from paraffine and chloroform, and finally wash slightly with distilled water.

Put the slide in a 1 per cent gold chloride solution and keep in the dark for 24 hours. Drain the slide and lightly apply a smooth-faced blotting paper to take up the surplus liquid. A $\frac{1}{10}$ per cent solution of gold chloride will answer, and is, of course, cheaper. Without further washing put the slide in a large bulk of 1 per cent formic acid and leave it for 24 hours. The longer diffuse daylight acts on the sections, the better the results. Wash in distilled water and mount in balsam. The sections may be cut very thin or thick—from 1μ to 15μ, but the author found the best results from sections 2 or $2\frac{1}{2}\mu$ in thickness.

"By this simple procedure, founded on a well known method, are produced the most beautiful pictures of the finer details of various tissues, but especially muscle and nerve fibres. The various elements of the tissue are stained in different tints from rose to cherry red or red-brown and are sharply defined."

A Rapid Method of Hardening and Sectioning.[2]—Every practical pathologist must be convinced of the great importance, in many cases, of at once supplementing and completing the naked eye examination of structures by a thorough microscopic examination. Microscopic examination in the fresh state, by teasing up parts of tissues, or by means of scrapings from the cut surface, is in most cases imperative if the finer details of the cellular elements are to be fully appreciated, but sections are no less necessary in many cases if the relations of the various constituents, and the structure with the tissue as a whole, are to be determined. In order to do this the method of freezing the fresh tissue, and cutting sections with the microtome is frequently adopted, but it must be the general experience that such sections are often very unsatisfactory. They are so loose and lacking in cohesion, and the process of freezing alters the tissue so much, that they are difficult to manipulate and often difficult to interpret. I have occasionally met with errors in diagnosis made by incompetent observers from the use of such sections. In order to obtain satisfactory results, the processes of hardening, embedding, section-cutting, staining, and mounting are all necessary, and these commonly extend over several days. If the process can be so shortened that the whole investigation can be completed at one sitting, then a considerable practical advantage will be obtained. How often does it happen in the course of a pathological investigation of parts either obtained post-mortem or from operation that we wish to be satisfied on the spot as to the real significance of some particular appearance. If the structure is put aside to harden, there is considerable likelihood of some of the points being forgotten, and, at any rate, it is not taken up with the freshness of the first examination. I believe also that for purposes of surgical diagnosis an examination made within an hour's time would often be found of great value.

The method I have now to describe has no claim except as a practical working procedure. I have mentioned it to several friends, and have met with a general expression of its usefulness. I have used it constantly for more than a year, and am perfectly satisfied that it fulfils its purpose. The principles of the method are: (1) rapid hardening in alcohol; (2) cutting with the microtome without removing the alcohol and without freezing the tissue; (3) rapid staining.

1. The hardening is effected by absolute alcohol, kept at a temperature about that of the animal body. In examining the fresh tissue

---

[2] Journ. Pathology and Bacteriology, II, No. 4, May, 1894.

with the naked eye the pathologist makes up his mind as to what exact parts he desires to submit to microscopic examination. With a sharp knife he takes a thin slice of such a part, not more than two to four millimetres in thickness and of comparatively small superficial area. The piece of tissue is placed in a test-tube containing some cotton-wool at the bottom, and half-filled with absolute alcohol. The slice is so placed in the tube that it shall lie flat and not be distorted or curved. The vessel is now to be placed at a slightly elevated temperature, for which purpose a water bath is most suitable. I use a hand basin, the hot tap of which is left running so as to keep the water at a temperature which may be judged of by the hand. The slight current in the water is a distinct advantage. If the piece be at all bulky it may be well to renew the alcohol after a short interval. In the course of half an hour or three quarters the slice of tissue will generally be found sufficiently hardened to be proceeded with further.

2. In the next stage advantage is taken of the fact that anise-oil freezes at a comparatively high temperature (45° to 70° Fahr.), and that the presence of alcohol does not interfere with the process of freezing. My attention was called to this agent by a paper by Kühne. This author recommends anise-oil as an embedding material, but I have not found the method which he recommends very successful. I use the anise-oil, not to penetrate the tissue, like celloidin or paraffin, but rather to hold it and fix it on the plate of the microtome. Having taken the slice of tissue from the alcohol, I dry it with blotting-paper or an absorbent cloth. I then pour a few drops of anise-oil on the plate of the freezing microtome, and place the piece of tissue in the midst of the oil. It is better to have the oil making one convex drop with the specimens in the middle of it, as in cutting the sections the less oil you take with you the better. A few systoles of the ether-spray bellows suffice to freeze the oil into a white solid mass. The knife is now used with a considerable sweep, and the section may be cut dry if its superficial area be small. If this cannot be done without risk of tearing, then the upper surface of the blade may be moistened with alcohol. The microtome which I use for the purpose is a Schantze, and any microtome with a sliding knife will serve. It is possible, by this method, to obtain sections sufficiently thin for most purposes, although not equal, of course, to those which may be got after embedding in celloidin or in paraffine.

In regard to the size of the piece of tissue to be cut, it is certainly better to have it of small dimensions, but the method is perfectly applicable to such a piece as would involve, say, the whole thickness of the kidney including cortex and pyramids.

After the sections are made they are placed in alcohol, which dissolves the anise-oil.

The sections so obtained may be stained with any of the ordinary agents. I used Biondi's fluid a good deal; it is rapid and differentiates well. Perhaps the most generally useful stain is Mayer's carmalum. This has all the advantages (and they are many) of alum-carmine, and has some additional ones of its own. Thus it is much brighter in tint, and so forms a better contrast. This is of special service when Gram's or Weigert's method is used for the detection of microbes, as the blue tint of alum-carmine is often objectionable when the microbes are stained blue. I commonly use picric acid as a contrast stain with the carmalum. The solution used consists of alcohol seventy parts, saturated watery solution of picric acid 30 parts, and hydrochloric acid ½ part. I find the results obtained to be much better than those yielded by picrocarmine in my hands. The whole process of staining by carmalum and picric acid need not take many minutes. If necessary a gentle heat may be used to hasten the action. An excellent method of staining, in many respects, is that described by Nicolle. It is introduced as a method of staining microbes which do not stain by Gram's method. The staining agent is Kühne's or Sœffler's blue. I have used, chiefly, Kühne's blue, which acts very rapidly, a few seconds being usually enough. It is so very vigorous, that dilution is sometimes necessary. The section is then washed in water and treated with a 10 per cent. solution of tannic acid. This has the effect of fixing the blue color in nuclei and microbes, so that subsequent treatment with alcohol and oil of cloves will not remove the color. The section is taken from the tannin solution, washed in water, dehydrated with alcohol, cleared with oil of cloves, washed in xylol, and mounted in Canada balsam in the usual way. If a contrast stain be desired, then eosin or acid fuchsine may be added to the tannin solution.

To summarise the method it may be put as follows:

1. Select an illustrative part of the fresh tissue, and remove a slice with a sharp knife.
2. Place in absolute alcohol and heat the vessel in a water bath to about 40° C. for half an hour to an hour.
3. Dry the tissue and place on the freezing plate of the microtome in a large drop of anise-oil.
4. Freeze and cut sections. The upper surface of the knife may be moistened with alcohol while cutting.
5. Place in alcohol to remove anise-oil.
6. Float out in water and place on slide for staining.
7. Stain by any approved rapid method, and mount.—JOSEPH COATS, M. D.

SCIENTIFIC NEWS.

Walker Prizes in Natural History.—Two prizes are annually offered by the Boston Society of Natural History for the best memoirs written in the English language on the subjects given below. For the best memoir presented a prize of sixty dollars may be awarded; if, however, the memoir be one of marked merit, the amount may be increased to one hundred dollars, at the discretion of the committee. For the next memoir, a prize not exceeding fifty dollars may be awarded. Prizes will not be awarded unless the memoirs presented are of adequate merit. The competition for these prizes are not restricted, but open to all. Each memoir must be accompanied by a sealed envelope enclosing the author's name and superscribed with a motto corresponding to one borne by the manuscript, and must be in the hands of the Secretary on or before April 1st of the year for which the prize is offered.

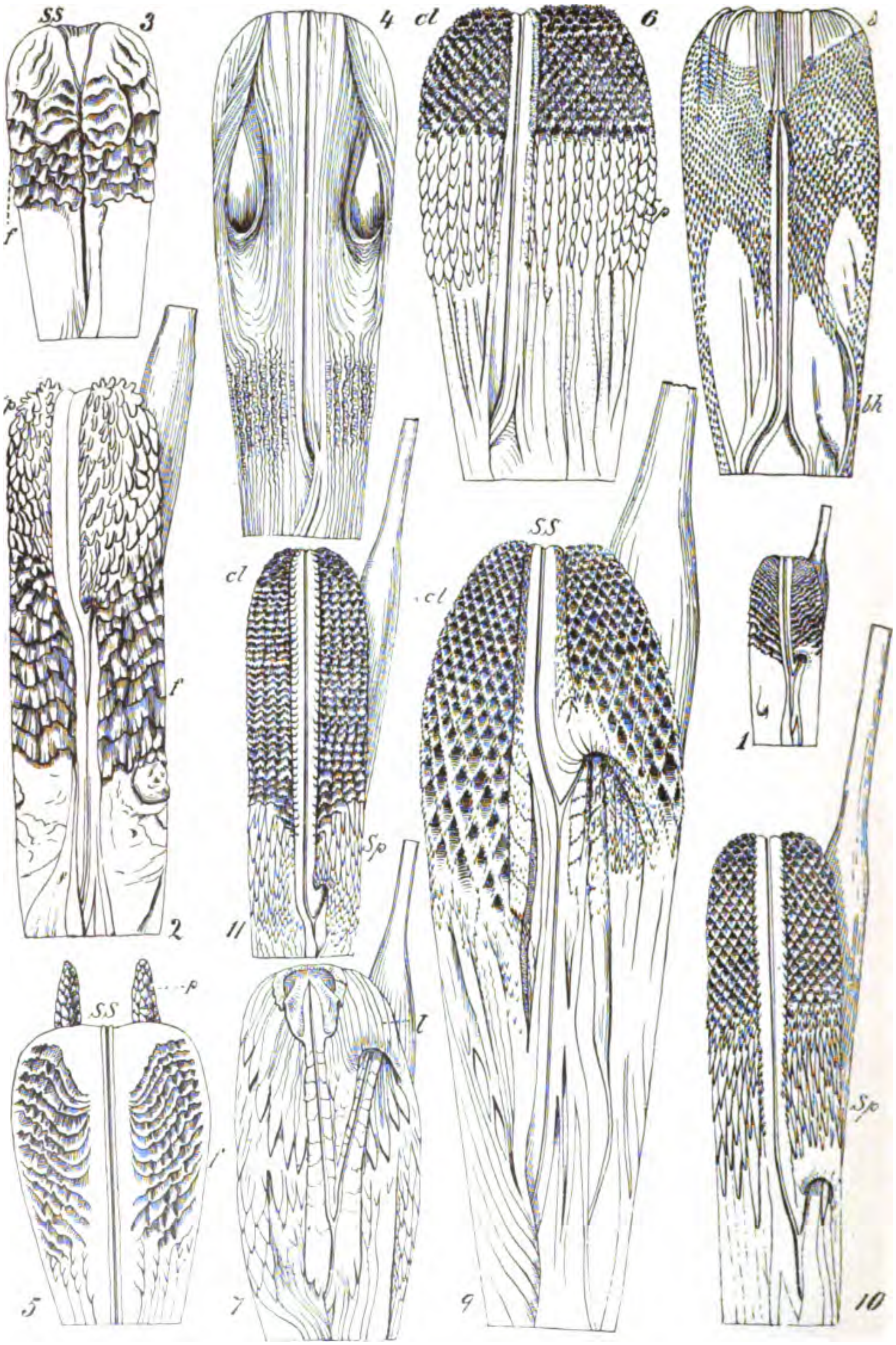
Subjects for 1895:—(1) A study of the "Fall line" in New Jersey; (2) A study of the Devonian formation of the Ohio basin; (3) Relations of the order Plantaginaceae; (4) Experimental investigations in morphology or embryology.

Subjects for 1896:—(1) A study of the area of schistose or foliated rocks in the eastern United States; (2) A study of the development of river valleys in some considerable area of folded or faulted Appalachian structure in Pennsylvania, Virginia or Tennessee; (3) An experimental study of the effects of close-fertilization in the case of some plant of short cycle; (4) Contributions to our knowledge of the general morphology or the general physiology of any animal, except man.

NOTE.—In all cases the memoirs are to be based on a considerable body of original work, as well as on a general review of the literature of the subject.

SAMUEL HENSHAW,
Secretary.

PLATE XXVII.



Hemipenes of Ophidia.

THE

AMERICAN NATURALIST

VOL. XXVIII. October, 1894. 334

THE CLASSIFICATION OF SNAKES.

BY E. D. COPE.

Owing to the absence of limbs and other points in which diversity is usually apparent, the classification of the snakes has always presented difficulties to the zoologist. An order which dates from Cretaceous time and has spread over the entire world, must have differentiated in structure, if its history has been like that of other orders of Vertebrata. Yet the researches of anatomists have only resulted in finding characters which define five suborders, and about a dozen families. Of the natural groups thus defined, one family, the Colubridæ, embraces three-fourths of the species, and is of cosmopolitan distribution. So long as this was the principal result attained, it remained clear that the stronghold of the order had not yet been taken.

The primary divisions above referred to, are defined by peculiarities of the skeleton, and these were mostly originally described by Johannes Müller. In the preparation of their Herpetologie Générale, Duméril and Bibron made a full study of the dentition. The results they obtained were important, but they were very far from expressing an exact and clear cut classification. The greatest defect of their definitions based on the teeth is that they too often fail to define. One type passes by easy gradations into another, so that in many cases it is im-

possible to determine what type a given dentition represents. In most cases it is clear that, among Colubrid snakes at least, no higher groups than genera can be predicated on dentition, and frequently not even these. Under such circumstances further structural characters had to be sought for if we are to have any clear idea of the affinities and phylogeny of this curious branch of the Reptilia. In any case no systematic arrangement can be regarded as final until the entire anatomy is known.

In 1864[1] I pointed out that certain snakes, notably the water snakes, have the vertebral hypapophyses continued to the tail, as in the truly venomous forms. Boulenger has since found this character in a good many forms which I had not examined, and which have no affinity to the water snakes. This character, while important, presents the same evanescent stages in certain types that the dental characters before noticed exhibit. It had long appeared to me that the only prehensile organs possessed by serpents, the hemipenes, might probably present structural variations expressive of affinity or diversity. In 1893[2] I examined these structures in many of the leading types, and was gratified by the discovery of a great many structural characters. In fact these organs exhibit a variety of ornamentation and armature beyond any part of the anatomy in the Ophidia, and I am satisfied that they furnish more important indication of near affinity than any other part of these reptiles yet examined. No one hereafter can be sure of the place of a serpent in the system until the hemipenis has been examined.

Still another part of the structure remained to be studied. The assymmetry of the lungs of snakes had often been noted by anatomists, but very little was known as to the range of variation. Accordingly the present year,[3] I undertook a study of the pulmonary organs. I was able to confirm observations previously made by Schlegel and Stannius, and to correct some others, and to add a great number of facts as to species not

---

[1] Proceedings Academy of Natural Sciences, Philada.

[2] American Naturlist, 1893, p. 477.

[3] Proceeds. Amer. Philos. Soc., 1894, p. 217.

previously examined. I cannot give here all the details observed, for which I refer to the papers quoted, but I give a general view of the results. One of these is that I am able to confirm the conclusion of Boulenger; i. e, that the Colubriform venomous snakes, the Proteroglypha, (cobras, Elapes, etc.), do not differ in any fundamental respect from the non-venomous Colubridæ, and that they can not be characterized as a suborder. The suborders then are:

Catodonta (Type Glauconia).
Epanodonta (Type Typhlops).
Tortricina (Ilysiidæ and Rhinophidæ).
Colubroidea (Peropoda, Asinea, and Proterogylpha).
Solenoglypha (Typical venomous forms).

The hemipenis is a projectile organ in the form of a hollow tube whose base is on one side of the middle line, and which opens into the anus. When retracted it lies beneath the tail, extending for a greater or less distance, and terminating in a cylindrical muscle. This has considerable length, and is finally inserted on a caudal vertebra. When the organ is projected this muscle is drawn forwards, so as to evaginate the tubular organ. Thus the inside of the tube becomes the outside, and the entire organ projects freely from its base anteriorly. It finds its way into the corresponding oviduct of the female (Plate XXVIII, v), and when once in place it cannot be tracted in most species, without invagination. This is performed by the contraction of the now internal retractor muscle. This is inserted on the internal face of the apex, and draws it inwards, so that it soon assumes the original ensheathed position beneath the tail. It cannot be withdrawn from the oviduct without invagination, because it is generally set with strong bony spines which diverge backwards. They have a perfect grip on the walls of the oviduct, and would in some instances lacerate that organ if the two bodies should be forcibly drawn apart. In other cases the hemipenis would be torn off at the base. Snakes sometimes partially project this organ, apparently in some instances for defence, as the spines are very pungent, and are sometimes curved like cats claws. Such at least would seem to have been the

case with two *Heterodon platyrhinus*, (spotted adders), which were brought to me with the organs projected so as to present the spines. They were caught by a cat, and were represented to me as fighting their captor in this and other ways. Snakes are, however, very careful not to present these organs fully evaginated so as to expose the delicate structures near the apex. I have never seen this to be the case in an alcoholic specimen, (with one possible exception), and I should judge that this was the general experience, from the figures given by authors. It is said that male snakes may be compelled to project the hemipenes by holding them before a fire, but I have not seen this.

The hemipenis of the Ophidia is traversed by a groove which divides the superficial investment to the internal integument (or external integument when the organ is retracted), which commences at the base internally, and soon turns to the external side of the organ and continues to its extremity. This is the sulcus spermaticus (s s in Plate xxvii). This sulcus is always bifurcated in venomous snakes, and I find it to be equally bifurcated in many harmless snakes (Figs. 2, 3, 7). The investing tissues may or may not correspond with this bifurcation. Thus the hemipenis may be more or less bifurcate (Figs. 1, 2, 7, 9, 10, 11). Schlegel states that it is bifurcate in venomous snakes, but it is not so in the sea-snake *Hydrophis hardwickii*, nor in *Bungarus semifasciatus*, *Hoplocephalus coronatus*, etc., while it is bifurcate in many non-venomous forms. Next to the bifurcation of the sulcus in importance, is the nature of the surface of the external investment (internal when retracted). In the most perfect types both venomous and non-venomous, this surface is reticulate like tripe, the enclosed areas forming calyces, which may have a suctorial function (Figs. 6, 9, 10, 11). Their borders are often papillose, and are sometimes so deeply divided into papillæ as to lose their original character. These papillæ may be the seat of osseous deposit, becoming bristles or spines, (sp), which become larger toward the middle of the length, and lose their mutual membranous connections. These isolated spines may extend to the apex, but they rarely extend to the base. The surface may, however, be laminate and not reticulate, and the laminæ may

be longitudinal (Figs. 4, 7) or transverse (Figs. 1, 2, 3, 5). In either of these cases they may not be spiniferous. The apex or apices of the organ may be furnished with a rigid papilla (Fig. 5) or awn.

In the Tortricina and Peropoda (the constrictors), the hemipenis is not spinous, and the sulcus is bifurcate (Figs. 1, 2, 3), and in the Boidae the hemipenis is bifurcate also, although in some genera (Xiphosoma, Ungualia), the branches are very short. The external integument is never reticulate, but is always laminate with elongate papillæ at the extremities, in Epicrates (Fig. 2), Xiphosoma, and Ungualia. The laminæ are pinnate from the sulcus as an axis, in Morelia, Enygrus, Lichanura and Eryx, and are transverse (flounced), in Charina (Fig. 3). In Ilysia they are pinnate (Fig. 1), with a few longitudinal plicæ below.

Similar gradations in the characters of the hemipenis are to be seen in the types of venomous snakes. Thus in the Proteroglypha this organ is spinous to the tip, on a calyculate basis, in Hydrophis, Elaps, (*surinamensis*); Dendraspis. It is reticulate at the extremities and spinous below, in Callophis (*bivirgatus*); Naja (Fig. 9); Acanthophis; Bungarus and Sepedon; the apex smooth in the two genera last named. In *Elaps nigrocinctus* the organ is smooth below, with spines at the apex.

In Solenoglypha the genus Atractaspis is spinous to the apex, apparently on a longitudinally laminate basis. In the Viperidæ and Crotalidæ the spines are on a flounced basis. The apices are calyculate in Bitis, Clotho (Fig. 10), and Vipera, and spinous in Cerastes. They are calyculate in Crotalidæ in Bothrops, Ancistrodon, Crotalophorus, Crotalus and Uropsophus (Fig. 11). In Crotalus (*durissus* of the Neotropical fauna), the papillae are not ossified; in all the other genera they are spinous.

The condition of knowledge as to the lungs of snakes was stated by Stannius, in 1856, as follows: "The detailed accounts as to the single or double character of the lungs leaves much to be desired. Among Ophidia Angiostomata there possess a single sack, Rhinophis and all Typhlopidæ

which have been examined; as to the Tortricidæ [Ilysiidæ], there are apparently species with two lungs (*T. xenopeltis*) [=*Xenopeltis unicolor*], and others with a single lung (*T. scytale*) [=*Ilysia scytale*]. Among Eurystomata, all the Peropoda (Boa, Python, Eryx) possess apparently two lungs. The Calamarina that have been investigated have one lung. Among Colubrina and Glyphodonta, there are great variations. All the Coronellæ of Schlegel possess, according to Schlegel, a single lung. I find the lung single in *Rhachiodon scaber* [*Dasypeltis*]. *Tropidonotus natrix* [*Natrix vulgaris*] has a very small rudiment of a second lung. *Coluber* [*Spilotes*] *variabilis* possesses, according to Schlegel, the rudiment of a second lung. According to the statement of Meckel, this rudiment is common in Coluber. The Xenodons have, according to Schlegel, a single lung (*X. severus* and *X. rhabdocephalus*). In Heterodon I find a rudimental second lung. The Lycodons, according to Schlegel, possess a single lung; as also do Psammophis and Homalopsis. In *Dendrophis colubrina* Schlegel found the rudiment of the second lung. In Dipsas, according te Schlegel, there are variations; but he states that *D. multimaculata, D. lævis* and *D. annulata* [*Sibon annulatum*], have but one lung. The Achrochordina have but one lung. Among Hydrophidæ I found in three species of Hydrophis the lung-sack simple. Meckel states that Platurus has a very small rudiment of a second lung. Among the remaining poisonous snakes there is an insignificant rudiment of the second lung in the Elapina and Crotalina; while the Viperina possess an entirely simple lung."

An examination of about one hundred and fifty species of nearly all types yielded the following results.

The snakes with rudimental posterior limbs (Peropoda), show in the character of their lungs, what they show in the rudimental limbs themselves, and in the hemipenis, the nearest relationships to the Lacertilia. They possess, with an exception to be noted later, two well-developed lungs, one of which is larger than the other. The smaller lung lies to the right side and ventrally, while the larger one lies to the left side and dorsally. In some species the dorsal and ventral

relation is more pronounced than in other. In the Colubroidea the right or ventral lung is generally present, but of very much reduced proportions, the usual size being from two to five millimeters in length (Plate XXVIII RL). It is connected with the other lung by a foramen which perforates the tracheal cartilage at a point a little beyond the apex of the heart, and opposite to the proximal part of the dorsal lung. It is sometimes connected to the dorsal lung by a short tube, in which cartilaginous half rings are seen in but two of the genera examined, viz., Heterodon and Conophis. The lumen of the rudimental lung may be lined by the same reticulate structure as is seen in the dorsal lung, or its walls may be smooth. In some Colubroidea the rudimental lung is absent, but such species are relatively few.

The dorsal lung may present proximally alongside of the trachea an auricle or pocket, and this is so developed in the genus Heterodon (Plate XXVIII), as to reach to the head, without communication with the trachea, other than that furnished by the normal portion of the lung. In the Solenoglypha, without exception, this extension of the dorsal lung is present, and extends to the head, and its lumen is continuous with the trachea throughout its length. The same structure exists in the genera Hydrus and Hydrophis; and also in the West Indian peropodous genus Ungualia, which differs besides from other Peropoda in having but one posttracheal lung. Finally the tracheal lung, as I shall call it, is distinct from the true lung in the water snakes Platurus and in Chersydrus. In the former of these genera the trachea is not separate from the lumen, while in Chersydrus it is distinct. It, however, communicates with the cells of which the lung consists in this genus by a series of regularly placed foramina on each side. There is no lumen in the tracheal lung of Chersydrus. In the blind burrowing Typhlops we have a still further modification of the tracheal lung. It is without lumen, and is composed of coarse cells of different sizes. These have no communication with the trachea or lung that I can discover. It has occurred to me that this structure, which extends from the heart to the throat, may not be a pulmonary organ.

In the fresh-water snakes (Natricinæ) there is no tracheal lung. The hemipenis of this group is very characteristic, (Plate XXXVII fig. 8).

As an illustration of the modifications in classification necessary in view of the characters which I have observed, I give an analysis of the genera of the group which I have called the Xenodontinæ.[4] These genera belong mainly to the southern Hemisphere, and chiefly to the Neotropical Realm, a few genera occuring in Africa and North America. The characters of the division are as follows.

Hemipenis with bifurcate sulcus spermaticus, and armed with well developed spines, which are developed from the marginal papillæ of calyculi, when the latter are present. Hypapophyses of the vertebræ generally present only anteriorly.[5]

A. Lung without large proximal diverticulum.

I. Apex of hemipenis without calyces or spines but with a membranous disc. (Disciferi Fig. 7),

φ. Rostral plate not recurved.	
Hemipenis undivided, no scale-pits;	*Aporophis* Cope,
Hemipenis divided; no scale-pits;	*Opheomorphus* Cope.
Hemipenis divided; one scale-pit;	*Xenodon* [6]Boie.
φφ. Rostral plate recurved.	
Hemipenis divided; one scale-pit;	*Lystrophis* Cope.
II. Hemipenis transversely plicated (divided); (Flabellati).	
Plicæ not pappillose; diacranterian;	*Helicops* Wagl.
Plicæ not pappillose; isodont;	*Pseudoeryx*[7] Fitz.
Plicæ pappillose; isodont;	*Rhabdosoma*[8] D. & B.
III. Calyculate, and not capitate (Calyculati).	
φ. Hemipenis undivided.	
Fusiform; isodont;	*Carphophiops* Gerv.
Colubriform; isodont; two nasals;	*Diadophis* B. & G.
Colubriform; diacranterian; one nasal;	*Amastridium* Cope.

---

[4] American Naturalist, 1893, p. 481.

[5] In Helicops they are continued to the tail.

[6] Including Liophis Wagl.

[7] Dimades Gray.

[8] Catostoma and Adelphicus are closely allied.

Colubriform; diacranterian; two nasals; *Hypsirhynchus* Gthr.
φφ. Hemipenis double.
Fusiform; isodont; *Farancia* Gray.
Colubriform; diacranterian; no scale pits; *Dromicus* Bibr.
Colubriform; diacranterian; one scale pit; *Monobothris*[9] Cope.
Colubriform; diacranterian; two scale pits; *Halsophis* Cope.
IV. Capitate (or pocketed) (Capitati).
φφ. Hemipenis undivided.
Scale pits single; scales smooth; *Pliocercus* Cope.
No scale pits; scales smooth; *Rhadinæa* Cope.
Scales keeled; prenasals in contact; *Tretanorhinus* D. & B.
φφ. Hemipenis divided.
Rostral normal; isodont; *Ninia* B. & G.
V. Pappillose at apex. (African) (Papillati).
Hemipenis single; *Grayia* Gthr.
Hemipenis bifurcate; *Theleus*[10] Cope.
VI. Calyculate with spinous bands to apex. (Calycispinosi).
Subisodont; attenuate; *Uromacer* D. & B.
VII. Exclusively spinous to apex; (diacranterian). (Spinosi).
Anterior teeth wanting; *Enulius* Cope.
Anterior teeth present; anal divided; no scale pits; *Echinanthera*[11] Cope.
Anterior teeth present; anal entire; one scale pit; *Acanthophallus* Cope.

A A Left lung with a proximal diverticulum, extending to the throat.

VIII. Calyculate and capitate.
Rostral recurved; hemipenis divided; diacranterian; *Heterodon* Beauv.

Any one familiar with these genera will perceive that they are not represented in a linear series in the table. He will also observe that genera of probably not very close affinities

---

[9] Gen. nov. Type, *Dromicus chamissonis* Auct.

[10] Amer. Naturalist, 1893, p. 482.

[11] Gen. nov.; type *Aporophis cyanopleurus* Cope. This species is thought by Boulenger to be *Natrix melanostigma* Wagl; but that species is represented as unicolor above. The present species has three longitudinal bands, one median and one on each side.

are placed close together, as for instance Tretanorhinus and Helicops[12] and their associates. This is, however, a necessity of an artificial key and is not new in zoölogy. The characters presented by the hemipenis are more readily determinable, and are more constant that those to be found in any other part of the structure.

In further illustration of the same subject I present a synopsis of another tropical group, this time entirely American, which only differs from the Xenodontinæ in the grooving of the posterior maxillary tooth, i. e., the Scytalinæ.

I. Apex without calyces or spines, but with a membranous disc. (Disciferi).
Hemipenis divided; *Erythrolamprus* Boie.
II. Hemipenis transversely or obliquely plicate; (divided). (Flabellati).
No calyces; rostral plate normal; *Jaltris* Cope.
Calyces at apex; rostral plate produced; *Conophis* Peters.
III. Calyculate and not capitate. (Calyculati).
φ. Hemipenis divided.
Rostral recurved; *Rhinostoma* Wagl.
Rostral normal; pupil erect; *Oxyrrhopus* Wagl.
Rostral normal; pupil round; *Philodryas* Wagl.
φφ. Hemipenis undivided.
Rostral normal; *Thamnodynastes* Wagl.
IV. Capitate (also calyculate). (Capitati).
Hemipenis undivided; colubriform; *Coniophanes*[13] Hallow.
Hemipenis undivided; fusiform; *Hydrocalamus* Cope.
V. Spinous to apex; (divided). (Spinosi).
Two nasal plates; *Tachymenis* Wiegm.
One nasal plate; *Tomodon* D. & B.
VI. Apex smooth, or with one row of spines; (divided). (Levi).
Urosteges one rowed; a band of minute calyces; *Scytale* Wagl.
Urosteges two rowed; no calyces; *Lygophis*[14] Tsch.

---

[12] Helicops is certainly to be placed in this family and has no relationship to the Natricinæ with which it has been hitherto associated.

[13] The penial characters of Coniophanes distinguish it from Erythrolamprus, with which I have proposed to unite it.

[14] Type *Lygophis elegans* Tsch.=*Dryophylax poecilostornus* Cope.

Comparison of this table with that of the genera of Xenodontinæ, shows that both present identical modifications of structure in the case of five of the subdivisions. Only two types, (V and VI), of the Xenodontinæ have not been found in the Scytalinæ; and one, (no. VI), of the latter group has not been found in the Xenodontinæ.[15]

EXPLANATION OF PLATES.

PLATE XXVII.

(From an unpublished Bulletin of the U. S. National Museum). Hemipenes of distinct types of Ophidia. The organ is split and the entire surface exposed. The student must remember that the lateral borders are artificial, and are continuous on the middle line behind the center of the figure in the projected organ. When the organ is bifurcate, but one branch is split; (figs. 1- 2-7-9-10-11).

Fig. 1. *Ilysia scytale* L. Brazil.
Fig. 2. *Epicrates angulifer* D. & B. Cuba.
Fig. 3. *Charina bottæ* Blv. Oregon.
Fig. 4. *Holarchus ancorus* Gird. Philippine Ids.
Fig. 5. *Oligodon subquadratus* D. & B. Java.
Fig. 6. *Bascanium constrictor* L. N. America.
Fig. 7. *Opheomorphus alticolus* Cope. Peru.
Fig. 8. *Natrix fasciata sipedon* L. N. America.
Fig. 9. *Naja haje* L. *melanoleuca* Hallow. W. Africa.
Fig. 10. *Clotho arietans* L. S. Africa.
Fig. 11. *Uropsopus confluentus* Say. Texas.

LETTERING.

ss. Sulcus spermaticus; *f,* flounces; *p,* papillæ; *cl,* calyces or calyculi (ruches); *l,* laminæ; *sp,* spines; *spl,* spinules.

PLATE XXVIII.

(From the Proceedings of the American Philosophical Society, 1894). Viscera of *Heterodon platyrhinus* Beauv. The

---

[15] Reflection has caused me to drop the major division Xenodontidæ, and to refer its two subfamilies to the Colubridæ.

heart is turned partly over, and the œsophagus is separated by being drawn to the left of the other viscera. One oviduct is split at the base so as to disclose the vaginal portion. In consequence the rectum is displaced to the right. The lettering is as follows.

Tr, trachea; *Car*, Carotid artery; *Hy* sheath containing hyoid cornua; *Oe*, oesphagus; *Vr*, vertebral artery; *A. P*, arteria pulmonalis; *L. L*, left lung; *R L*, right, (rudimental) lung; *H*, heart; *A R*, left aorta root; *V C*, vena cava ascendens; *L*, liver; *St*, stomach; *G B*, gall bladder; *Sp*, spleen; *F*, fontanelle of oviduct; *I*, intestine; *Ov*, ovary; *C A*, corpus adiposum; *K*, kidney; *Od*, oviduct; *R*, rectum; *U*, ureter; *V*, vaginal portion of oviduct; *Cl*, cloaca.

LIMITS OF BIOLOGICAL EXPERIMENTS.[1]

BY DR. MANLY MILES.

The proposition to test theories in evolution by direct experiments on living organisms which has been favorably noticed, and the numerous futile feeding experiments that have been made at the Government experiment stations, raise the question as to the probable limits of direct experimental methods in dealing with biological problems. The "whirligig of time," in connection with a certain uniformity in the outcome of the modified processes of nutrition and reproduction in a number of individuals, must be regarded as essential elements in bringing about the gradual aggregation and perpetuation of the minute changes in living organisms which we recognize as processes of evolution.

Aside from these significant factors, which cannot be neglected, the exceedingly complex conditions involved in all biological activities appear to be formidable difficulties to overcome in attempting a direct experimental verification of theories relating to the various agencies concerned in evolution, or, in determining the relative value of foods in the processes of nutrition.

Intelligent breeders of domestic animals have no doubts in regard to the heredity of acquired characters, which, in the light of their experience, they look upon as a fundamental principle in stock breeding and one of the most important factors in the available means of improvement. The direct proof of this principle by experimental methods must, however, be difficult, if not impossible, notwithstanding the cumulative and apparently conclusive evidence presented in the history of the improved breeds, and the experience of successful breeders who have recognized its importance in the improvement of their animals.

The dominant influence of other known biological factors may completely obscure well marked special characters that

---

[1] (Abstract of a paper read at the Brooklyn meeting A. A. A. S., Aug., 1894).

have undoubtedly been inherited, as in the familiar facts of atavism, and they must effectually prevent the detection of the initial stages in the development of any new characters under investigation, which may in fact have been potentially transmitted for a number of generations.

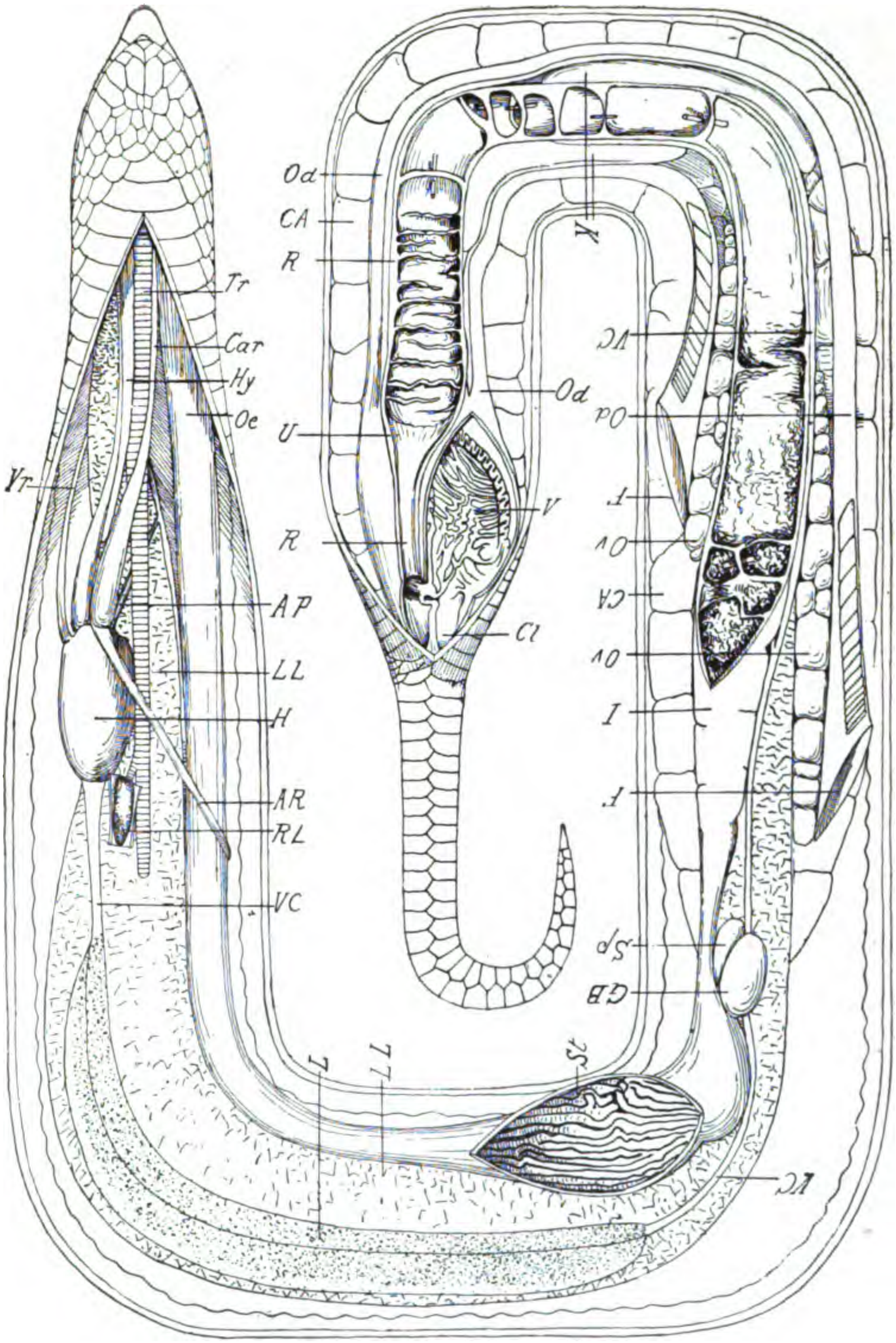
Reversion, prepotency, and the influence of a previous impregnation, are conspicuous obstacles in the way of tracing the immediate, or incipient indications of the inheritance of any particular acquired character which it may be desirable to perpetuate by judicious selections.

In many of the arguments relating to the heredity of acquired characters it appears to be tacitly assumed that each particular character is transmitted as an entity, regardless of its interdependent relations to other parts of the organism, and especially with the specific functional adaptations of the organs of nutrition which have made its development possible.

As pointed out in a paper read in Section F, at the Rochester meeting of the Am. Ass. Adv. Sci., physiological changes in the organism must precede any manifest modification of structural characters, and the transmission of a morphological peculiarity must, therefore, involve the transmission of the functional activities through which it has its origin. It was also shown that a habit or bias of the nutritive processes in a certain direction, may be transmitted for a number of generations without any visible morphological evidence of its existence, and that, in the lapse of time, it may lead to the development of obvious structural changes that are recognized as new characters. Experimental methods in biology are too crude to admit of a recognition of these preliminary steps in the development of new characters, which must be taken into account in making a satisfactory verification of any of the processes of evolution.

The artificial conditions to which our domesticated plants and animals are subjected, intensifies their susceptibility to variation, and there appears to be a constant tendency to reversion when any unfavorable conditions prevail in their treatment. Under ordinary management, repeated systematic

PLATE XXVIII.



Heterodon platyrhinus Latr.

selections are necessary in order to maintain the highest development of the most desirable characters, and a considerable number of individuals will be required to make any marked improvement in special qualities, as all do not respond alike to the artificial modifying conditions of their environment.

There are also individuals that retain a tendency to the prepotent transmission of the old race characters, notwithstanding the high development of the particular improved characters they possess, and a pedigree, showing that all known ancestors have had the desired qualities, is looked upon as a valuable index of the dominant inherited characters.

Even the best established breeds fail to exhibit the uniformity in their general characteristics which prevails in wild species that have been subjected to the more rigorous and discriminating processes of natural selection. The methods of artificial selection in the breeding of animals, are lacking in the inexorable consistency and comprehensiveness that characterize natural selection. The breeder of improved animals is unable to perceive all of their innate and acquired physiological tendencies, and his selections are made with reference only to the most obvious peculiarities, or qualities, and he overlooks and neglects many of the factors concerned in determining the correlated relations of the sum of their characters.

Feeding experiments to ascertain the relative nutritive value of different articles of food and the advantages of different methods of feeding, or, to determine the relative merits of different breeds, are especially liable to mislead, from the complexity of the problems presented—the small number of facts under observation—and the practical difficulties in the way of tracing the obscure relations of the most significant factors in the phenomena under investigation, to say nothing of the fallacious and obsolete chemical theories of nutrition that are too often adopted in a popular discussion of the results.

It is not my purpose to enter upon an exhaustive discussion of the limits of experimental biology, but to point out some

of the practical difficulties involved in its methods and results. Without further reference to particulars, it must be evident that biological activities have such complex interdependent relations, that theories relating to evolution cannot all be verified, or practical problems in nutrition satisfactorily solved, by direct experimental methods.

ABALONE OR HALIOTIS SHELLS OF THE CALIFORNIAN COAST.

MRS. M. BURTON WILLIAMSON.

Although the coast of California produces, as a rule, dull or sombre tinted shells, yet in one family of molluscs the Californian province stands preëminent. This family is composed of shells familiary known on the West Coast as Abalone or pearly-ear shells. Among scientists the shells are called *Haliotis* and the family Haliotidæ. In the size of all its species of Haliotidæ California rivals the world. Japan has one fine species *Haliotis gigantea* Chemnitz, that compares very favorably with the large shells of California, and this species is also represented on the West Coast of the U. S. by a variety. Another fine shell that compares favorably with the Californian shells is *Haliotis midæ*, the first shell of this family named by the great Linneus or Linnè, who described it in 1758. Australia also produces a large species, but for the most part shells collected on other coasts are small, ranging from four to one inch in length.

In the geographical distribution of this family, the "center of distribution is in the Australian and adjacent seas."[1] Besides those collected on the coast of California and Lower California, these shells are found as far north as Alaska, also on the coasts of Kamtchatka, Japan, China, Philippine Islands, New Hebrides, New Caledonia, New Zealand, Aukland, Id., Australia, Malay Archipelago, Ceylon, Red Sea, West Coast of Africa and at the Cape of Good Hope, Canary Islands, Mediterranean and Adriatic Seas, French and English Coasts of the Atlantic, and also at the Cape region of South America. It has often been remarked that "not a single species" has been "found upon either coast of South America, or upon the East Coast of North America," but, in 1869, Pourtales dredged a small Haliotis in 200 fathoms near the Florida reefs. The

---

[1] Pilsbry.

shell was named by Dr. Wm. H. Dall *Haliotis pourtalesii*, but in the great fire of 1871 in Chicago, this little specimen together with the "entire collection of Pourtales and Stimpson," was burned. In 1887–88 the U. S. Fish Commission Steamer Albatross dredged a number of shells on the West Coast, and, at the Galapagos Islands, in the Pacific, on the West Coast of South America, two specimens of *Haliotes* were dredged. And, what is remarkable, the shell found in Florida from the bed of the Gulf Stream and the one from the Galapagos group were pronounced by Dr. Dall the same species with scarcely a doubt. The latter did not contain the animal and was not quite one inch in length.[2]

In the Manual of Conchology, Mr. H. A. Pilsbry says of the family Haliotidæ in geologic ages: "Of the genealogy of the family little is known. A few fossil forms not differing materially from the recent ones, have been discovered in the Pliocene and Miocene and one in the upper Cretaceous of Germany. Others will probably be found when the Australian Tertiary and secondary strata are more fully explored." Two species of Abalones are found in the Quarternary or Plistocene formation in Southern California.

There are about 85 species and well defined varieties of shells in this family. On the Californian coast six distinct species are collected and also two or three varieties. Some of these species are found as far south as Cape St. Lucas, Lower California, and one species extends to Alaska; this is supposed to be a variety of the Japanese species, reaching the Californian coast by way of Alaska. The species is *Haliotis gigantea* Chemnitz var. *H. kamtchatkana* Jonas. Besides this northern species, *H. rufescens* Swainson, *H. fulgens* Philippi; *H. corrugata* Gray, *H. cracherodii* Leech and *H. assimilis* Dall are collected. The last named is a deep water species.

The generic name *Haliotis* was also given by Linné in 1758. It is from the Greek *hals*, sea and *ous* ear, but wherever these shells are found they have local names. In California they are popularly known as "Abalone," of "uncertain ety-

---

[2] See Preliminary Report on Albatross Mollusca by William Healey Dall, Curator Dept. Molluscs. (Proc. Nat. Mus., Vol. XII, 1889).

mology." Some writers think the name is of Spanish origin[3] but a well known Spanish scholar, one of the Jesuit Fathers, told me he thought the name was a "provincialism." It is said these shells are called "Awabi" in Japan. The local names given to the shell in different countries refer usually to the shape of the shell, and, being translated, mean ear-shell, ear-of-the-sea, Venus' ear, etc.; also on account of its nacreous lining, Mother-of-pearl-shell, and because of the holes in the shell, "six eyes." The beautiful nacre or mother-of-pearl in the interior of these shells, and the rich colors visible when the epidermis or outside layer has been removed, has given rise to color names. The most beautiful shell, in the interior, is the green abalone (*Haliotis fulgens*). The green and blue nacre is as effectively blended as the colors in a peacock, and is indiscribably rich in tone. The centre is especially rich in iridescent effect. This center is scientifically known as the "muscular impression" for it is at this place that the animal is firmly adherent to its shell, though young shells are not marked by this "area of the muscular impression." In some specimens it is horse-shoe-shaped. In an article on the Abalone Fishery in "The Fisheries and Fishing Industries of the U. S." (U. S. Commission of Fish and Fisheries 1887), Earnest Ingersoll says in referring to this muscle scar: "In aged specimens the part to which the muscle is attached is raised above the level of the rest of the interior and presents a roughened or carved surface of irregular shape, often fancifully imitative of some other object. The writer has seen one which thus contained a singularly correct profile of Napoleon I." Instead of the muscular impression being "raised above the level," my observation has led me to conclude that with age the muscle scar is, as a whole, depressed.

The red abalone (*H. rufescens*) does not receive its name from the color of its mother-of-pearl, as does the green shell, but from the red margin that outlines the aperture and the beautiful red displayed on the outside when the shell is decorticated by the use of acids or the grindstone. Another species (*H. cracherodii*, named for a Mr. Cracherod) when submitted

---

[3] From *aulon* or *aulone*.

to the same treatment shows a black exterior and this is the "black abalone." It is also called the "white abalone" in reference to its pearly interior and exterior, if the calcareous layers have been ground off leaving only the mother-of-pearl on the outside, as is often the case. A species with corrugations (*H. corrugata*) presents a reddish-purple color when ground off by a skillful workman. All these shells take a beautiful polish, but, while the shells are made more attractive to the popular taste, scientifically their value is depreciated after they fall "victims," as Carpenter expresses it, "to the grindstone and acids." Physicists tells us that the play of tints visible in the nacre or mother-of-pearl is caused by the action upon light of the tiny layers composing the nacre. "These layers are microscopically corrugated and their edges meet the rays of light and partly decompose them as do the rain drops in a rainbow producing a play of colors." (I once dissolved the inner layers of an abalone shell in muriatic acid, the dish was placed aside for several hours and on seeing it again I was surprised to find a beautiful sediment of iridescent mother-of-pearl; pressure was applied, and the play of colors was gone. The result was new to me at that time and was a pleasant surprise).

Typical shells of the Gastropoda (so named because the "under side of the body forms a muscular foot for gliding along"), the class to which abalones belong, are spiral in their form. Although these shells appear flat, a close inspection shows a well developed spire, but in most species, the spire is small and the basal or body-whorl is unusually developed and depressed, and this gives the shell an appearance as though it were only one valve of a bivalve, for which it has often been mistaken when seen by persons unacquainted with these forms. The shells have a row of open holes usually from five to nine, on one side, but these vary in number as the animal grows older; the holes close, until old shells have been seen with only one or two holes left open.[4] These holes are on the left side of the shell and through them the tentacles of the animal are often protruded. When the animal is resting upon

[4] A California Conchologist has a shell with *all* the holes closed.

a rock, a slight blow upon the shell often causes the shell-fish to adhere more firmly to the rock and at the same time discharge jets of water out of every hole. When entirely at rest the abalone adheres to the rock and is as completely covered by his shell as a watch would be under an inverted saucer, excepting that the five or more holes in the shell admit the entrance and exit of water. The large muscular foot with its epipodial ridge bordered with cirri extends outside of the shell when the animal is gliding along. This foot is to all appearances only a muscular expansion of the body. The animal has no operculum or trap-door, as in most families of this class, as it is like the limpet in having no use for an operculum. Abalones have a short head and eye peduncles. The gills or branchia, intestines, etc., are all on the same side of the shell as the holes, and the "columellar margin is produced into a flattened spiral plate," that forms a ridge sufficiently broad to protect all the digestive organs. The heart has two lateral auricles. The mantle is cleft at the row of holes extending thus "as far back as the last open hole." The odontophore[5] or radula is large, and the variety and size of the teeth on this lingual ribbon can be seen without the aid of a microscope. A section of the odontophore makes one of the most attractive mounts furnished by the radula of molluscs.

Reference was made to the fact that sometimes old shells had only one or two holes open when the animal was very old; when such is the case the shell is usually covered with a growth of vegetation, worms, or other molluscs. Whole colonies of *Serpulorbis* attach themselves to one shell making a very heavy load for a shell-fish to carry, even one so muscular as the abalone. Although they do travel somewhat, it is not improbable that with age the animal becomes more and more sedentary until almost incapable of locomotion. An abalone brought from the Pacific, about 24 miles away, after it had shown very little appearance of life, crawled from a pail of sea water, eighteen inches in one night, where it was found dead in the morning. The abalone marks his passage by a

---

[5] The ondontophore, sometimes called the "tongue" or "lingual ribbon" is set with rows of sharp siliceous teeth. In a large abalone it is about 3 inches in length.

trail of mucus in the same way that a land snail (*Helix*) leaves a trace of secretion in his wake. Besides the extraneous growth on these shells, they are the home of numerous pholads which burrow into the shell the same as into soft rock. The little domiciliary squatters often cause protuberances in the interior of the shell where the borer has drilled through the epidermis and calcareous portions into the nacre, which is always supplied sufficiently to resent the encroachments of domiciliaries. Dr. Robert E. C. Stearns of the National Museum has written an interesting paper on animals that encroach on the domain of others,[6] and it is illustrated with a plate showing these protuberances in an abalone shell. A red abalone that showed, on the inside, the raised nodule or protuberance indicative of the presence of a small rock-borer, on the outside of the abalone showed no perforation as usual, but, instead, there was a round depression of nacre, the pholad (? *Penitella parva* Tryon) *had been completely covered with nacre*, but a hammer and a chisel discovered the little bivalve that had been sealed up in his own domicile. As I broke the little pholad in getting it out of the abalone shell it could not be identified otherwise than doubtfully.

As pearls consist of coatings of nacreous secretion they are sometimes found in abalone shells. These will not compare with pearls found in the pearl oyster, as the latter are unrivalled. Pearls in abalones are often pear-shaped and green in color, in fact some of these so-called "pearls" are peculiar rather than beautiful. One fine pearl *baroque* (irregular) was taken from under the columella margin of a green abalone. It is the property of Mrs. Prof. Lowe of Pasadena, S. California, and is about 2⅝ inches long; it is three-cornered in shape, and at the widest and thickest part it is 2¼ inches around.

As is well known the habitat of abalone is among rocks, where, at *very low* tide, they may be found huddled together in a corner of a rock in a rock pool, or hedged in between fissures of immense rocks, always as though hiding from the

---

[6] On certain Parasites, Commensàls and Domiciliaries in the Pearl Oyster, etc. (Smithsonian Report, 1886, pages 339–344, with three plates).

light. Their dingy exterior almost of the same color as the rocks on which they rest, make them scarcely noticeable save for the protuberances that are visible on the rocks from which they are very difficult to remove, a trowel or wedge, etc., being necessary to dislodge them. Fishermen and Chinamen are the principle collectors of abalones. To illustrate the strength of muscle developed in this shell an anecdote is sometimes told of a man who was collecting some shells, when one of the shell-fish drew his shell so closely to the rock the man's hand was securely pinned to the rock and he was drowned. At one time the man is a Mexican, at another a Chinamen; the occurrence at one period is at Santa Barbara, at another San Pedro, but, the story always begins with "I have heard, etc." Any one who has collected these muscular fellows would be wary about allowing even a finger to be in close proximity to the shell, nor is it necessary to do so, the trowel or tool used to dislodge the shell is all that is needed. That men have lost their lives while collecting these shells there is no doubt at all, as the tide sometimes comes with fearful force on the slippery rocks. Three or four years ago the local papers reported the drowning of a young fisherman while getting abalones at San Pedro. Last spring a San Francisco paper told how a coyote was entrapped in a Haliotis which the coyote found partly raised from a rock, and, on inserting his muzzle underneath to secure a breakfast, the abalone had "closed down on him and kept him a prisoner."

As an article of food it is the general impression that the Chinese are the only consumers, but this is a mistake, although as an article of commerce only the Chinese seem to value it highly. At a lonely "point" in one of the Palos Verdes Hills we once found a large number of abalone shells around a deserted camp-fire, the fish had evidently been cooked on the fire, then eaten from the shell by the fishermen. A slice of abalone, before it is cooked, laid upon a platter might easily be mistaken for a slice of fish. They are pounded before cooking. As a soup this shell-fish is said to be very palatable and it has frequently been mistaken, by the uninitiated, for clam soup. As an export the fish is dried after being removed

from the shell. I have seen three and four dozen abalones dried and strung on a cord, in Mexican grocery stores, hung beside dozens of strings of red peppers or chilles so gratifying to the Mexican palate. Abalones, when dried, have the appearance of leather, excepting that they are oily in their appearance. In shape they are nearly oblong and two or three inches thick. The great muscular foot slopes backward over an inch before it is enlarged by the epopodial ridge with its numerous cirri, and this contraction is noticeable in the dried fish.

As an article of commerce the shells are of considerable importance, or rather have been, as it is said, the immense traffic has almost "stripped the coast as far south as Cerros Island," Lower California. Three hundred tons are said to have been shipped from the coast in one year. Fifty tons being handled by one man in a month's time. "The greater portion of these are (in 1889) collected on the coast of Lower California. The Chinese are the principal gatherers, notwithstanding they are probibited by the Mexican laws. The shells are sold at $20 to $35 per ton, according to the quality."[7] When shells are sold by the bulk there is always a large percentage of dead and imperfect specimens, as the best shells are picked out and sold to retail dealers on the coast. A shell that is perforated by worms or molluscs is of no value as a polished shell. When the animal has been removed from the shell and the latter has laid on the beach subjected to the sun and the weather, the mother-of-pearl becomes dull and unattractive, and such shells are known as dead shells.

In California dead shells collected on the beach are often used, instead of stones, for rockeries, and also as borders for flower beds. It would be impossible to enumerate the ornamental uses to which abalones are applied. "In China they are broken up and used for inlaying in connection with lacquer work for which the Chinese are famous. The Mosaics of Europe are often adorned in the same way." Although the pearl oyster (*Maleagrina margaritifera*) is used where a pearly-white tint, such as seen in the pearl handles of silver table

---

[7] The West Amer. Scientist, April, 1889, p. 12.

knives, etc. is desired, yet in mosaics and work enriched by a display of iridescent tints the nacre of abalone shells stands preëminent. Inlaid work is so universally used that an enumeration of articles ornamented in this way is unnecessary, but mention may be made of one use of these shells in lacquer that to an American or European may seem unique; its use in a "pillow end." When we think of a pillow we imagine a billowy roll all done up in white, but, a Japanese or Korean has a very different idea. In the Korean collection in the U. S. National Museum are some small pillows and the following description is given of the ends of two of them:[8] "Pillow end (Be-ga-mo). Circular piece of wood, lacquered, incrusted with Haliotis shell. Figures represent a tiger under a pine tree; along the border is a band of arabesque." "Pillow end (Ja-ga-be-ga-mo). Disk of wood fastened in the end of a cylindrical pillow case, in black lacquer with Haliotis shell. Subject, the great dragon rising from the sea into the sky in the spring season." In describing these pillow ends Mr. Walter Hough says: "The Korean pillow is a cylindrical case stuffed with hair or rice straw. It has ornamented ends. The first one mentioned is 8¼ inches in diameter, but is 'not part of a regular pillow,' being used as a 'arm-rest.' The second one is 8 inches in diameter."

As a medium for trade among the Aborigines of North America, abalones have been highly esteemed both for their beauty and importance when used as shell money. The shells in the latter case being cut "into oblong strips from one to two inches in length, according to the curvature of the shell, and about as third as broad as long." These were strung on a string and were used both as money and ornaments. Dr. Robert E. C. Stearns, Adjunct Curator of Molluscs in the National Museum, has written a comprehensive monograph upon the use of shells by the Indians, entitled "Ethno-Conchology, a study of Primitive Money," and in it is figured money made from abalones, which the Indians termed "Uhl-lo." In the recent excavations at the old historic town of

---

[8] Report of the U. S. National Museum, 1891, page 465.

Pachacamac, near Lima, Peru,[9] squares of mother-of-pearl were found in the graves of the Incas. These squares are only half the length of those figured in Dr. Stearns' paper. The pieces look like the nacre of abalones and each square has two holes drilled in it. As the graves, or burial place of Pachacamac is supposed to be over four hundred years old, these shell pieces are very interesting, revealing also the fact that the Incas considered shell ornaments valuable enough to be buried with their bodies. As these strips of solid silver, done up in a loosely woven cloth, were found in a mummy's hand, the pieces of shell were evidently not used as money, the silver having been cut for that purpose.

Dr. Stearns instances the purchasing power of an abalone from the fact that in New Mexico a horse had been traded for a shell. I was relating this incident to a friend who had spent some years with the Pueblos in New Mexico, and my friend said that that was not surprising, as, when she first went to New Mexico, some years ago, her brother bought her a good Mexican horse for $6.00, and the Indians were always as glad to receive attractive shells as money. This would not be a very extravagant price for an Indian to pay for a fine Haliotis, as a shell dealer once listed to me *H. fulgens* as high as $10.00. Whether any conchologist paid such price is unknown to me, but, a red abolone, when decorticated, has sold in Los Angeles for $5.00, but it was a large specimen and beautifully polished.[10] Like other commodities abalone shells are variable in price according to the demand, as well as quality.

[9] In the private collection of C. F. Lummus, Los Angeles, Cal.

[10] It is related that as high a price as $25.00 has been asked for an abalone having a peculiar muscular impression outlined in the interior of the shell.

THE DURATION OF NIAGARA FALLS.

By Dr. J. W. Spencer.[1]

For the past century Niagara Falls has been considered a time measurer, but its greatest interest has risen since the growth of our knowledge of the Ice Age on acconnt of the expectation that in some way it can be made to tell something of the date of that period and indirectly of the advent of man, or his restrictions on account of the glacial conditions. The paper of which this is an abstract was primarily a physical study, setting forth the changing episodes in the history of the falls, and computing the age of the river, but leaving to others the application of the results in the question of early man.

The method of determining the age of the falls is the application of the mechanics of the river to the various conditions during the changing episodes of its history, in a large measure discovered by the author during the last fifteen years. The investigation differs from those of other writers who have simply divided the length of the chasm, excavated by the retreating falls, by the imagined or measured rate of the recession of the cataract. At a glance, even the most superficial reader can understand that if the height of the cataract be first reduced to one-half, and then again doubled, or if the volume of the river be reduced to one-fourth, such variations are bound to produce as great changes in the rate of recession as are indicated by the mechanical laws; and that if the conditions have not always remained constant, then the present rate of retreat has not always obtained—sometimes slower and sometimes faster. It is this question that the paper considers for the first time. In the much written, but, until recently almost unknown, history of Niagara River, we find that an approximately correct estimate of the age of the falls was made half a century ago by Lyell, upon a conjecture of the rate of re-

---

[1] Abstract of a paper read before the Am. As. Ad. Science at Brooklyn, August, 1894.

cession now known to be wholly erroneous. Again, within the last eight years, there have been several writers who have been using corrected cöefficients of retreat, still their results are more inaccurate than the guesses, as to the age of the falls, made a hundred years ago, yet they may be said to have approximated the truth within their observations, but the observations have become enlarged.

A hundred years ago, Andrew Ellicott estimated the age of the falls at 55,000 years. Forty years later, Bakewell made the falls about 12,000 years old. Over fifty years ago, Lyell conjectured the age at 35,000 years, and this estimate was commonly accepted until about a decade ago. The foundations for the measurements of the retreat of the cataract were laid by Professor James Hall, when he made the first preserved instrumental survey of the cataract in 1842. Since then, measurements have been repeated in 1875 by the Lake Survey; in 1886 by Professor W. S. Woodward, and in 1890 by Mr. Aug. S. Kibbe. From these surveys the mean rate of modern recession of the falls is found much more rapid than was formerly supposed, as it amounts to 4.175 feet a year, and if the history of the falls had been uniform, then the age would have been only 9,000 years—not so different from the guess of half a dozen years ago, which took the maximum medial retreat of the cataract, and made the age only 7,000 years. Had the gentlemen taken the mean rate as then known, which the scientific methods dictated and since supported by the action of the river, they should have made the age of the falls 11,000 years, near which estimate some did. This point is noticed on account of many secondary writers finding the number 7,000 years as agreeable to their theories.

Owing to some structural variations, I have taken 3.75 feet a year as the mean rate to be adopted for the retreat of the falls mechanically applied to the different conditions of the river. These have been occasioned by the changing heights of the falls and the volume of the water. With regard to the latter point, it has been found that for three-fourths of the duration of the river, the drainage of Lake Huron and the upper lakes was by way of the Ottawa River, and not by way

of Lake Erie and the Niagara. Under these conditions only $\frac{3}{11}$ of the present discharge of the Niagara River cascaded over the falls. The episodes of the river are as follows: First episode: water descending 200 feet, volume $\frac{3}{11}$ of the present (when the falls was of about the magnitude of the present American cataract), chasm excavated (as shown by the position of terraces) 11,000 feet; time required, 17,200 years. Second episode: descent of the river in a series of three cascades aggregating 420 feet at first with only the Erie drainage (during the recession of 3,000 feet) and afterwards the present volume of water (when the recession amounted to 7,000 feet) duration 10,000 years. Third episode: river descending 420 feet in one cascade with the present volume; time required, for the recession of 4,000 feet, only 800 years. Fourth episode was somewhat complicated, with the water mostly descending 320 feet, and during this condition the falls have receded 11,500 feet, and required a period of 3,000 years. Thus the age of the falls has been computed at 31,000 years. But at the beginning, the river flowed from lake to lake without a falls, and this time has been taken as 1,000 years; accordingly, the age of the river is computed at 32,000 years. The record of the changing levels may be seen in the deserted beaches now high above the lakes which have already been described in scientific journals. The investigations doubtless contain some errors which may be corrected in the future, but in the history of the lakes the present computations are very strongly confirmed by much cumulative evidence so that the present results appear to be approximately correct. It is further estimated that with the earth movements continuing as at present, the end of the falls will be effected by the change of the drainage from the Niagara River to the Mississippi, by way of Chicago, owing to the rise of the eastern rim of the Erie basin above the barrier now separating the lake waters from the Mexican drainage. With the present rate of elevation continuing, the future life of the river ought to be 5,000 or 6,000 years.

In regard to the relation of Niagara River to the Ice Age, I estimate that the lake epoch commenced from 48,000 to

64,000 years ago, and that for several thousands of years before the birth of the river there was open water far northeastward of the river. Some writers think that the St. Lawrence Valley was obstructed by ice until a late date. This is a question to be determined; but however it may be, there has been free communication for the drainage of the Ontario basin for at least 14,000 years. Whether the end of the Ice Age were 60,000 or 14,000 years ago, all glacial obstructions had retreated to at least from 400 to 600 miles to the north and east of the Great Lakes fifty milleniums ago. The lake region was roamed over by mastodons, elks and beavers, but we do not know of the presence of man. If such be found, anthropologists will have all of these years to consider in fixing the antiquity of man. The story of Niagara River forms an interesting chapter in the physical growth of the lakes, and gives us an approximate idea of the duration of the lake epoch which was characterized by the last touches in the fashioning of the continent, and fixes the height of the Ice Age a very long time ago.

One point more should be noticed. An error has prevailed for fifty years in that it was supposed that the ancient Niagara drainage was by way of the Whirlpool, (St. David's) Ravine. This has been found erroneous, owing to the occurrence of rock across the Whirlpool Ravine at an elevation of about 170 feet above the surface of Lake Ontario.

RECENT BOOKS AND PAMPHLETS.

ADLER, H.—Alternating Generations. A Biological Study of Oak Galls and Gall-Flies. Translated and Edited by Mr. C. R. Stratton. Oxford, 1894. From the Pub., McMillan & Co.

ANDREWS, C. W.—On some Remains of Æpyornis in the British Museum (Nat. Hist.). Extr. Proc. Zool. London, 1894. From the author.

BATHER, F. A.—Natural Science in Japan. Extr. National Science, Vol. IV, 1894. From the author.

BITTNER, A. VON.—Zur neueren Literatur der Alpinen Trias. Separat. Abdruck aus dem Jahrb. der k. k. geolog. Reichsanstalt, 1894. Bd. 44, Heft. 2. Wien, 1894. From the author.

BROWN, A. P.—A Comparative Study of the Chemical Behavior of Pyrite and Marcasite. Reprint, June 19, 1894, from Proc. Amer. Philos. Soc., Vol. XXXIII. From the author.

Bulletin of the U. S. Fish Commission, Vol. XI, 1891. Washington, 1893. From the Smithsonian Institution.

CHAMBERLAIN, M.—A Popular Handbook of the Ornithology of the United States and Canada, based on Nuttall's Manual. Vol. I, Land Birds; Vol. II, Game and Water Birds. From the author.

Congrès Géologique International, Compte Rendu de la 5me Session, Washington, 1891. Washington, 1893. From the Bureau.

DAVIS, W. M. AND GRISWOLD, L. S.—Eastern Boundary of the Connecticut Triassic. Extr. Bull. Geol. Soc. Am., Vol. 5, 1894. From the author.

DEPERET, C.—Sur un gisement siderolithique de Mammifères de l'éocène moyen à Lissien, près Lyon. Extr. Comptes-Rendus, Paris, 1894. From the author.

Fifth Annual Report of the Missouri Botanical Gardens. St. Louis, 1894. From the Trustees of the Garden.

GAGE, S.—The Microscope and Microscopical Methods. Ithaca, 1894. From the author.

GARMAN, H.—The Orthoptera of Kentucky. Extr. Sixth Ann. Rept. Ky. Agric. Exper. Station. No date given. From the author.

Geological Maps of Schuylkill, Carbon, Berks and Dauphin Counties, Pa.——Topographical Map of the Blue Mt. and Port Clinton, Pa., in two sheets, 1891. ——Atlas Summary Final Report, 1893. From the Pennsylvania Geol. Surv.

HARLE, E.—Découverte d'ossements d'Hyènes rayées dans la grotte de Montsaunés (Haute-Garonne). Extr. Comptes-Rendus, Paris, 1894. From the author.

KEYES, C. R.—Coal Deposits of Iowa. Iowa Geol. Surv., Vol. II. Des Moines, 1894. From the author.

LYDEKKER, R.—Life and Rock. London, 1894. From the author.

LYMAN, B. S.—Some New Red Horizons. Reprint, June 19, 1894, from Proc. Amer. Philos. Soc., Vol. XXXIII. From the author.

MASON, O. T.—Migration and the Food Quest. A Study in the Peopling of America. Extr. Amer. Anthrop., 1894. From the author.

MERRIAM, C. H.—Abstract of a Study of the American Wood Rats, with Descriptions of fourteen new species and subspecies of the Genus Neotoma.——Preliminary Descriptions of eleven New Kangaroo Rats of the genera Dipodomys and Perodipus. Extr. Proc. Biol. Soc., Washington, 1894. From the author.

NEHRLING, H.—Our Native Birds of Song and Beauty, Vol. I. Milwaukee, 1893. From the author.

NISBET, J.—Studies in Forestry. Oxford, 1894. From Macmillan & Co., Publishers.

PACKARD, A. S.—On the Inheritance of Acquired Characters in Animals with a complete Metamorphosis. Extr. Proc. Amer. Acad., 1894. From the author.

RAUFF, H.—Paleospongiologie; in Paleontographica herausgegeben von K. A. v. Zittel. Vierzigster Band, 56 Lief. Stuttgart, 1894. From Herr von Zittel.

Report of the Commissioner of Education 1890–91, Vol. I, Vol. II. Washington, 1894. From the Bureau of Ed.

ROMANES, G. J.—Darwin and after Darwin. Chicago, 1893. From the author.

SCOTT, D. H.—Structural Botany. Flowering Plants. London, 1894. From Macmillan & Co, Publishers.

SCUDDER, S. H.—Tertiary Tipulidae, with Special Reference to those of Florissant, Colorado. Extr. Proceeds. Am. Phil. Soc., Vol. XXXII. From the author.

SPRATT, L. Man in Continuation at this earth of a Nature of Reality Throughout the Universe by Tradition of that Reality from its Original Universe of Force. Washington, 1894.

STRONG, O. S.—The Structure and Homologies of the Cranial Nerves of the Amphibia as determined by their Peripheral Distribution and Internal Origin. Part 2. Extr. Zool. Anz., 1892. From the author.

Tenth Annual Report of Ethnology, 1888, 1889. Washington, 1893. From the Smithsonian Institution.

T. E. S. T.—Two Spheres or Mind *versus* Instinct. London, 1894. From the author.

Thirty-sixth Annual Report of the State Horticultural Society of Missouri, 1893. Jefferson City, 1894. From the Soc.

TODD, J. E.—Pleistocene Problems in Missouri. Extr. Bull. Geol. Soc. Am. Vol. 5, 1894. From the Society.

Twelfth Annual Report of the U. S. Geological Survey, 1890–91. Part I, Geology; Part II, Irrigation. From the U. S. Geol. Surv.

UDDEN, J. A.—Erosion, Transportation and Sedimentation Performed by the Atmosphere. Extr. Journ. Geol., Vol. II, 1894. From the author.

VINES, S. H.—A Student's Text-Book of Botany. London, 1894. From Macmillan & Co., Publishers.

WARD, L. F.—The Cretaceous Rim of the Black Hills. Extr. Journ. Geol., Vol. II, 1894. From the author.

WARD, L. F.—Principes et Méthodes d'étude de Correlation Géologique au Moyen des Plantes Fossiles. Extr. du Compte-Rendu de la Cinquième Session du Congrés Géologique International. Washington, 1891. From the author.

WATERS, B. H.—Some additional points on the Primitive Segmentation of the Vertebrate Brain. Separat. Abd. aus dem Zool. Anz., No. 362, 1891. From the author.

RECENT LITERATURE.

The Colorado Formation.[1]—This memoir by T. W. Stanton is published as Bulletin, No. 106 of the U. S. Geol. Survey. It comprises the descriptions and illustrations of all the species that can now be assigned to the fauna, thirty-nine of which are believed to be new to science. In an introductory chapter the author defines the Colorado formation, describes local sections, and gives faunal lists that show the vertical range and areal distribution of most of the species. This formation has been recognized by means of its characteristic fossils in Iowa, Minnesota, the Dakotas, Nebraska, Kansas, Colorado, Wyoming, Montana, Utah, Arizona and New Mexico. Equivalent strata exist in Texas and the adjacent regions, and over large areas in British America. As yet it is unknown east of the Mississippi, but it may have an equivalent on the Pacific coast, as one of its most characteristic fossils, *Inoceramus labiatus* is reported from the Upper shales and sandstones of the Queen Charlotte Island.

Mr. Stanton considers the fauna, as a whole, the taxonomic equivalent of the Turonian, as first pointed out by Cope.

The memoir is richly illustrated with 45 page plates of drawings carefully finished in detail.

Our Native Birds of Song and Beauty.[2]—This work by Mr. Nehrling is designed to awaken a love for nature among young people and particularly to interest them in bird-life so that they will not only protect it, but they will also study the habits and learn the haunts of birds with the view of fostering them by providing suitable nesting-places. It is issued in quarto form and the publishers have left nothing to be desired in the way of paper, type, and all that goes to present a book in an artistic form. The complete work will be a treatise on all the native North American Birds from the Thrushes to the Parrots. Vol. I, which is now at hand, carries the reader through the Swallows. An introductory chapter contains brief remarks on birds prized for their song or beauty, their habits, migration, their utility, their enemies, their protection; and the acclimatization of exotic birds. Then follow

---

[1] The Colorado Formation and Invertebrate Fauna. By T. W. Stanton. Bull. of the U. S. Geol. Surv., No. 106. Washington, 1893.

[2] Our Native Birds of Song and Beauty. Vol. I. By Henry Nehrling. Milwaukee, 1893.

descriptions of species and with each description the author gives an account of the habits and habitat, based chiefly on his own observations. In every case the local name is given in addition, and no effort is spared to combine scientific accuracy with popular diction. The plates by Ridgway and Mützel are admirable specimens of color printing.

Cartailhac's Prehistoric France.[3]—This work forms one of the Bibliothéque Scientifique Internationale Series, and like the rest of that set aims to embody the leading facts of the subject treated in brief essay which shall be at once both popular and scientific. M. Cartailhac's opening chapter is a history of the progress of the science of archeology, and contains a resumé of the important discoveries made in France. Then follows a discussion of the evidence for the existence of preglacial man, and a presentation of the undoubted facts concerning his appearance during early Plistocene. Under the head "artistic manifestations," are described the drawings and sculptures by primitive man, and the conclusions drawn from a comparison of the work with that of uncivilized man of the present day. A chapter on human bones discovered in the Alluvium and another on the mortuary customs as evidenced by the position, condition and surroundings of the skeletons discovered in caverns and burial-places closes the history of Paleolithic man.

Of Neolithic man M. Cartailhac makes a longer story. The grottoes, both natural and artificial, used as sepulchres, and the strange megalithic crypts, are very fully described, together with the funeral rites of the ancient Gauls. Ethnographic comparisons are made with living races, particularly as to the custom of erecting stones as monuments. Finally a discussion of the type of Neolithic man as revealed by the Cro-Magnon and other skulls found within the last few years brings to a close this interesting work on prehistoric man.

The volume forms one of the series edited by M. Lanessan, and it is of importance as furnishing a review of what has been discovered in that richest of all fields, France.

Report of the U. S. National Museum for 1892.[4]—This report comprises the Reports of the Assistant Secretary of the Smithsonian Institution upon the condition and progress of the Museum; Reports of the Curators; Paper's illustrative of collections in the Museum; A Bibliography; and List of Accessions. Shufeldt's Paper on scientific

---

[3] La France Préhistorique d'aprés les Sépultures et les Monuments. Par Emile Cartailhac. Paris, 1889.

taxidermy is beautifully illustrated. The author criticises the results attained by workers in the Museum, viewing the subject from the standpoint of an artist and biologist. Other important and interesting papers are Dr. White's discussion of Biology in its relation to geological investigation, and a description of Japanese Wood-cutting and Wood-cut Printing by T. Tokuno, chief of the Bureau of Engraving and Printing of Japan. This paper is also finely illustrated.

Marsh on Tertiary Artiodactyla.[5]—In this paper we have another characteristic production of its author. Thirteen alleged new species, three alleged new genera, and three alleged new families, are named. To point out how far they are described, and are not duplications of other work, is the object of the following pages. The three " new " families are not described at all, not a single character being assigned to any of them. No reasons are given to show that they differ from each other or from families already known. The three new genera are described, but are not compared with genera already known out of North America. One of them (Agriomeryx, p. 270) is identical with the Coloreodon Cope, described in 1879[6] and figured in 1884 and 1888[6]. In addition to these three genera, references are made to nine other alleged genera named by the author in previous publications. Taking these up seriatim, the first in order is called Eohyus, which name was used without accompanying description in an address delivered by Prof. Marsh and published in 1877. The introduction of this and other new names in this way in that address gave them no authority, and other names applied to the same types at subsequent dates, if accompanied with a description, would necessarily be used. But if not so replaced, this rehabilitation after seventeen years, should be such as to satisfy the rules of nomenclature. But what is now offered to us? The only diagnosis of Eohyus vouchsafed to us, is that "the type specimen is a last upper molar and the characters of its crown are well shown in the figure," which accompanies the text. This will scarcely do as a generic diagnosis, and no other specimens represent the species and genus! Yet on the strength of this material he bases the " new " and undefined " family Eohyidæ." The specimen comes from the Wasatch of New Mexico. He then describes most imperfectly, and without figure, an alleged second species from the Puerco formation,

---

[4] Report of the U. S. National Museum for the year ending June 30, 1892. Washington, 1893.

[5] Description of Tertiary Artiodactyles by O. C. Marsh. Amer. Journ. Sci. Arts, 1894. Sept., p. 259.

[6] Proceedings American Philosoph. Society.

which he, as usual, calls the lower Wasatch, (again in defiance of the rules) thus assuming that a genus of this group is common to the two formations, an assumption only to be made on far better evidence than is here offered. He next states that the name of the Puerco genus Periptychus Cope is "preoccupied," but does not point out how or where. Scudder's Index shows that a division (not a genus) of Lepidoptera has been called Periptyches, which is not preoccupation. The entire proceeding is an attempt to make something out of nothing and is unworthy of a place in a scientific Journal.

The next genus mentioned is called Parahyus Marsh, which name was given in 1876. Osborn has regarded it as identical with Achænodon Cope, 1873, and no characters have been assigned which will distinguish them. The next name is Homacodon, which was given by Marsh without generic diagnosis in 1872. Two "new species" are named, but not described, but they are supposed to be introduced to science by figures of two astragali! The author asserts that the genus which I described, also in 1872, under the name of Pantolestes, includes species of "Homacodon." As the type of Pantolestes is from the same horizon as Marsh's specimens, it is probable that Homacodon is a synonym of that genus. If so, the superior molars are quadritubercular, since Marsh so figures them in the present paper. It is, therefore necessary to give the tritubercular form from the older Wasatch horizon another name. For this genus, whose type is the *Pantolestes brachystomus* Cope, I propose the generic name of Trigonolestes. The proper description of the *Homacodon vagans* by Marsh in 1872 would have prevented the reference to the same genus of the Wasatch forms in 1884.

The next genus proposed is Nanomeryx, which is defined. The type and only species is called *N. caudatus*, but is not described, except by the statement that it is half as large as the *Pantolestes* (*Homacodon*) *vagans*, and by reference to figures of the inferior end of the tibia, and the astragalus. Rather hard lines for paleontologists who shall hereafter desire to identify the species! We next reach the so-called genus Helohyus, which Marsh on a previous occasion alleged to be identical with Phenacodus. He does not repeat this statement in this paper, but says that it is suilline and therefore a member of another order. Two figures show that the two forms are also very distinct as to dentition. The name was originally proposed by Marsh in 1872 without generic diagnosis, and no diagnosis is given now, so that the field is still open to any one who may be able to properly characterize it. The abortion of another generic name given by himself by its union with "Helohyus," is a step made by the author in the right direction.

Our author next enumerates certain selenodont Artiodactyla from the Eocene system. Here we have an attempt to rehabilitate three generic names, enumerated, but not sufficiently or not at all described in the address of 1877 before referred to, and without mention of type species. The first of these (Eomeryx) has been since well described by Scott and Osborn, (in 1889), who show that the form is allied to Oreodon. Their name, (Protoreadon), has the right of first description and should be retained. The next genus, Parameryx, is described sufficiently to ensure its adoption, if it is distinct from the various allied European forms, with which, as usual, no comparison is made. The species ("*P. laevis*") is not described, but future students are expected to identify it from two figures, one of an upper molar, and the other of the astragalus. A second supposed species is very insufficiently described. Unfortunately for the adoption of the name Parameryx, the genus was, according to Marsh, described by Scott and Osborn in 1889 under the name of Leptotragulus. This publication contained the first description of the genus, hence the latter name must be retained. The third name of the address was "Oromeryx." It was not described, nor was any type species mentioned. The omission as to description is now supplied, but specific and family characters are confused by being mixed with the generic.

Under the head of Miocene Artiodactyles, we find the genus Coloreodon Cope redescribed under the name of Agriomeryx as already noted. The only species named is not described, but a part of the skull is figured, which does not offer any difference of specific value from the *C. ferox* Cope. The next form referred to is the suilline genus named but not described by Marsh in 1875 as Thinohyus. It has been impossible hitherto to locate this genus from Marsh's paper, but the figures of a few molar teeth now given throw some light on the subject, but as hitherto, no distinct description of the genus is given. Next follows a fuller description than usual of a new species of Leptochoerus Leidy. The author says that the molar teeth resemble those of the alleged genus Helohyus, but the figures show that they are very different. A suspicion of this seems to have been present to the author, who proposes to place the genus in a new family the "Leptochoeridæ," which as usual, he does not characterize. The last feat of Prof. Marsh which I shall notice, is that of naming a supposed new species of Procamelus on a figure of the calcaneum only! He states that the bones were found in the Pliocene of the John Day region of Oregon, meaning probably Loup Fork. Pliocene beds do not contain the genus Procamelus.—E. D. COPE.

General Notes.

MINERALOGY.[1]

Crystallization of Enargite.—Pirsson[2] has studied enargite from two new Colorado localities, viz., the Ida Mine, Summit District, and the National Belle Mine, Red Mountain. At the former locality the mineral is deposited in cavities left after the kaolinization of feldspar phenocrysts in porphyry. These crystals are tabular parallel to $\infty\ P\bar{\infty}$, and are bounded by the forms $\infty\ P\bar{\infty}$, oP, ∞P, and $\infty P2$. At the latter locality two types of crystals are found. One of these is in thick, striated prisms bounded by the same forms as the Ida Mine crystals and sometimes in addition $P\breve{\infty}$, $P\infty$, $\infty\ \bar{P}_2$, and another brachydome. The second type of crystals from this locality is tabular parallel to the base and shows hemimorphic development. The forms observed on this type are oP, $\infty P\infty$, ∞P, $\infty P3$, $P\breve{\infty}$, $\frac{3}{4}\ P3$.

Crystallization of Scolecite and Meta-scolecite.—Rinne[3] has investigated crystals of scolecite from Iceland and shown that the mineral crystallizes in the rare inclined-faced hemihedral division of the monoclinic system. This fact was developed by etching and by study of the pyroelectric properties. The front faces of the prism have different etched figures from the rear faces, while in twinned crystals with the twinning plane the ortho-pinacoid, front and rear faces of the prism have the same figures. In simple individuals the front and rear faces are pyroelectrically positive and negative poles respectively. In twinned crystals all prism faces are positive and a negative zone follows the twinning line on $\infty P\breve{\infty}$ with neutral bands on either side.

When crystals of the mineral are heated much above 120° C they become cloudy, and the crystal structures seems at first sight to be lost, but by brightening up in oil it is found that a molecular rearrangement has taken place. This new mineral Rinne calls meta-scolecite. The inclined-faced hemihedrism of the monoclinic system is retained, but a remarkable revolution of the molecular groups through

---

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Am. Jour. Sci., (3) xlvii, pp. 212–215.

[3] Neues Jahrb. f. Mineral., etc., 1894, II, pp. 51–68.

an angle of 90° about the 'c axis has taken place. The ortho-pinacoid has become the clino-pinacoid and vice-versa. The twinning plane of twinned crystals has undergone the same revolution. By heating crystals beyond the temperature required for producing the first meta-scolecite, the double refraction of the substance steadily decreases and the symmetry approaches more and more closely to the orthorhombic. Below red heat the structure breaks down. As scolecite possesses three molecules of water of crystallization, Rinne suggests that the first meta-scolecite contains two, the second one molecule of crystal water, the crystal structure being lost when all the water has been removed.

Crystallization of Herderite.—Penfield[4] has made a study of herderite from the known localities as well as from a newly discovered locality at Paris, Me. The herderite from the latter locality as well as that from Hebron, contains scarcely any fluorine, its place being taken by hydroxyl, and the author proposes for it the name hydro-herderite. As the Stoneham herderite contains hydroxyl and fluorine in the proportions of 3 : 2, the one apparently replacing the other isomorphically, the name hydro-fluor-herderite is proposed for such intermediate varieties between theoretical fluor-herderite and hydro-herderite. In the crystallographic study the fact is brought out that the mineral is monoclinic instead of orthorhombic as has been supposed. This is proven not alone on Paris specimens but on specimens from the other localities, which were reexamined for this purpose. The crystals, however, approach closely to the orthorhombic system, the hydro- fluor-herderite being more nearly orthorhombic than the hydoherderite, the substitution of fluorine for hydroxyl tending to increase the crystallographical axial angle and to shorten the clino-diagonal. It likewise diminishes the mean index of refraction and the optical angle.

Composition and Related Physical Properties of Topaz.—Jannatsch and Locke[5] have shown that topaz contains water of constitution, from a chemical study of specimens from San Louis Potosi, Ilmen Mts., Schneckenstein, and Brazil. Penfield and Minor[6] have independently established the same fact by a larger number of analyses, and shown how this greatly simplifies the formula of the mineral on

---

[4] Am. Jour. Sci., (3) xlvii, pp. 329-339.

[5] Am. Jour. Sci., (3) xlvii, pp. 386-387.

[6] Ibidem, pp. 387-396.

the assumption that hydroxyl and fluorine are isomorphous. Their results show that whereas the ratio $SiO_2 : Al_2O_3 : F$ varies from 1 : 1 : 1.50 to 1 : 1 : 1.84, the ratio $SiO_2 : Al_2O_3 : (F. OH)$ is constant and 1 : 1 : 2, so the formula of topaz becomes $(Al\ [F. OH]\ )_2\ SiO_4$ or $(Al\ [F. OH]_2)\ Al\ SiO_4$. Their study of the physical properties of the mineral establishes a definite relation between them and the per cents of fluorine and water present, clearly indicating the isomorphous character of the fluorine and hydroxyl. The hydro-topaz has the smaller optical angle and the smaller specific gravity. The same fact is brought out by the determined values for α, β, and γ, and by exact measurements of interfacial angles. The optical anomalies of some Brazilian crystals are explained by zonal growth of topazes of different composition.

Composition of Chondrodite, Humite, and Clinohumite.—Penfield and Howe[7] have undertaken the study of the composition of the members of the humite group with the result not only of bringing order out of chaos, but also of establishing the fact that chondrodite, humite, and clinohumite constitute an homologous series both in a chemical and in a crystallographical sense. Sjögren has assumed that fluorine and hydroxyl are isomorphous, and derived new formulas for the members of this series, but as the authors point out the older analyses which Sjögren utilized are low as regards water, and Sjögren neglected to take into account the replacement of magnesia by ferrous iron and the consequent lowering of the silica percentage. The formulas derived by the authors, reckoning ferrous iron as magnesia, are as follows:

Chondrodite	$Mg_3\ (Mg\ [F. OH])_2\ (SiO_4)_2$
Humite	$Mg_5\ (Mg\ [F. OH])_2\ (SiO_4)_3$
Clinohumite	$Mg_7\ (Mg\ [F. OH])_2\ (SiO_4)_4$

The common difference of this homologous series is a molecule of chrysolite, $Mg_2\ SiO_4$. As shown by Sacchi and vom Rath, if the 'c, axis of crystals of chondrodite be divided by 5, that of humite by 7, and that of clinohumite by 9, the axial ratios of the three minerals become practically identical. Now these divisors, 5, 7, and 9, are the same as the number of magnesia atoms in the formulas of the corresponding minerals. A most interesting relation is thus brought out connecting the crystal forms and chemical compositions of the members of this group. The authors think it probable that other members of this series will be discovered, such as a mineral of the composition $Mg\ (Mg\ [F. OH])$,

---

[7] Am. Jour. Sci., (3) xlvii, pp. 188–206.

SiO_4. This compound should have either orthorhombic or monoclinic symmetry, with β equal to 90° and an axial ratio $a : b : c = 1.086 : 1 : 1.887$.

Leucite from New Jersey.—Kemp[8] argues for the presence of partially decomposed leucites in a dyke rock at Rudeville, Sussex Co., N. J., from a micro-chemical test indicating the presence of potassium, and from remains of leucite twinning, in spheroids now largely made up of analcite, calcite, feldspar, and other supposed secondary products.

Variscite from Utah.—Packard[9] gives an analysis of a specimen of compact or cryptocrystalline variscite from a quartz vein near Lewiston, Utah. The analysis is as follows:

H_2O 22.95 P_2O_5 44.40 Al_2O_3 (By difference) 32.65.

Utilization of Auerbach Calcite for Nicols.—An attempt has been made[10] to utilize the clear calcite from Auerbach on the Bergstrasse, Germany, for Nicol's prisms. Four ordinary Nicols with inclined end faces were prepared by Schmidt & Haensch of Berlin, and although these are equal to the medium quality Nicols prepared from Iceland spar in the matter of extinction, they nevertheless contain inclusions, air bubbles, etc., which are visible even to the naked eye. Dr. Hoffman, the owner of the Auerbach quarries, still hopes to secure material pure enough to take the place of Iceland spar. The material already tested will suffice for technical purposes.

Crystallization of Willemite.—Willemite has been supposed to have rhombohedral tetartohedral symmetry from the similarity of its rhombohedral angles to those of phenacite. Penfield[11] studies crystals from the Merritt Mine, N. M., Sedalia Mine, Salida, Col., and Franklin, N. J. In the specimens from the first and last mentioned localities, rhombohedrons of the second and third orders were observed and measured, showing that the system is what has been supposed. On the crystals from the Merritt Mine the second and third order rhombohedrons are $\frac{\frac{4}{3}P2}{4}\frac{l}{r}$ and $\frac{\frac{4}{5}P\frac{4}{3}}{4}\frac{r}{l}$ respectively. One of the types from the Franklin Mines is terminated by a third order rhombohedron $\frac{3P\frac{3}{2}}{4}\frac{l}{r}$ alone, thus resembling the phenacite crystals from Mte. Antero, Col.

---

[8] Am. Jour. Sci., (3) xlvii, pp. 339–340.

[9] Am. Jour. Sci., (3) xlvii, pp. 297–298.

[10] Zeitschrift für Instrumentenkunde, 14te Jahrgang (1894), p. 54.

[11] Am. Jour. Sci., (3), xlvii, pp. 305–309.

The author shows that the cleavage of willemite is like that of troostite, indistinct cleavages parallel to both the base and prism being made out in willemite.

Composition of Staurolite and Arrangement of its Inclusions.—Exceptionally pure material for analysis was obtained by Penfield and Pratt[12] from St. Gothard, Switz., Windham, Me., Lisbon, N. H., and near Burnsville, N. C. A powder of uniform specific gravity was obtained in each case by the use of fused silver nitrate as a separating fluid in a specially constructed apparatus, the heavier and lighter portions of the powder being in this way removed. Reckoning MnO and MgO as FeO, and Fe_2O_3 as Al_2O_3, the four specimens yield results that agree well and indicate clearly that staurolite has the empirical formula $H\,Al_5\,Fe\,Si_2O_{13}$ as already suggested by Groth. The silica alone does not agree closely with this formula, being in every case about one per cent too high, and the authors think that this is due to the presence of inclusions of quartz too minute to be separated from the powder. Carbonaceous inclusions are in the staurolite from Lisbon, N. H., arranged in the same manner as in chiastolite crystals. The explanation of the authors is that the crystals of staurolite in growing in a solid rock, find it difficult to exclude foreign substances, the tendency to include them being greatest at the crystal edge and greatest where the interfacial angle is largest.

Determination of Quartz and the Feldspars in thin Section.—Sometime since Becke described a method of distinguishing quartz from feldspar by treatment with hydrochloric acid and subsequently tinting. He now[13] applies the same method to distinguish orthoclase from plagioclase and to determine the particular plagioclase species. Orthoclase is less affected by acid than plagioclase, and the soda rich plagioclases are less affected than the lime rich species. In rocks containing quartz, orthoclase and plagioclase, the slide is etched until by tinting the plagioclase shows an intense color. The orthoclase will then be faintly tinted and the quartz entirely unaffected.

Continuing his study Becke[14] has devised methods for the same determinations based on differences of refractive index. The first method consists in the examination of a perpendicular contact plane between

---

[12] Am. Jour. Sci., (3), xlvii, pp. 81-89.

[13] Tscherm. min. u. petrog. Mitth., xii, Heft 3, p. 2 (Notizen).

[14] Sitzungsber. d. k. Akad. d. Wissensch. i. Wien, Math. Naturw. Classe, Bd. II, Abth. I, pp. 358–376, July, 1893.

the two minerals with a cone of illumination of small angle. When properly focused, this contact appears as a sharp line. On raising the tube of the instrument, the focus is disturbed and a light band appears on the side of the contact toward the more refractive mineral, which band widens and finally fades out as the tube is raised higher. If, on the other hand, the tube be lowered, the same phenomena appear on the other side of the contact. The best results are obtained with the use of high powers and with a cone of illumination of small angle. Becke recommends the use of the *Irisblende* furnished with the newer instruments of Fuess. I have obtained good results with a small Voigt and Hochgesang instrument by removing the weak convex lens which covers the polarizer. Becke's *Schlierenmethode* makes use of inclined illumination, which is obtained with the *Irisblende* or with Abbe's *Beleuchtungsapparat.* With inclined illumination, that side of a section of strongly refracting mineral toward the direction from which the light comes, shows a light band against the less strongly refracting mineral surrounding it, while the opposite side shows a dark band. The author states that this method suffices to determine orthoclase, quartz, and a plagioclase when they are present together in a holocrystalline rock, but suggests that it be supplemented by the *Färbung* method. The method of determining the species of plagioclase depends on the comparison of the double refraction of the feldspar with that of quartz sections. By making per cents of *An* the abscissæ, and indices of refraction the ordinates, curves are obtained for α, β and γ within the feldspar series. These curves are intersected by the horizontal curves of ω and ϵ in quartz. If now α' and γ' be the less and the greater values respectively of the refraction for the two principal directions in any section of plagioclase, α' being between α and β and γ' between β and γ, the curves obtained indicate the following relations:

	Parallel Position		Crossed Position		Composition.
I	$\omega > \alpha'$	$\epsilon > \gamma'$	$\omega > \gamma'$	$\epsilon > \alpha'$	Ab —$Ab_8 An_1$
II	$\omega > \alpha'$	$\epsilon > \gamma'$	$\omega = \gamma'$	$\epsilon > \alpha'$	$Ab_8 An_1$—$Ab_3 An_1$
III	$\omega = \alpha'$	$\epsilon > \gamma'$	$\omega < \gamma'$	$\epsilon > \alpha'$	$Ab_3 An_1$—$Ab_2 An_1$
IV	$\omega < \alpha'$,	$\epsilon = \gamma'$	$\omega < \gamma'$	$\epsilon > \alpha'$	Ab_2 An—$Ab_3 An_2$
V	$\omega < \alpha'$	$\epsilon < \gamma'$	$\omega < \gamma'$	$\epsilon = \alpha'$	$Ab_3 An_2$—Ab An_1
VI	$\omega < \alpha'$	$\epsilon < \gamma$	$\omega < \gamma'$	$\epsilon < \alpha'$	$Ab_1 An_1$—An_1

It is seen that these subdivisions of the plagioclases correspond in a general way to the earlier one of Tschermak, I being albite, II and III oligoclase, IV and V andesine, while VI includes labradorite, bytounite and anorthite. As Tschermak's later and more equable subdivi-

sion of the series has not been generally accepted, Becke thinks the harmony between his natural table and the older scheme of Tschermak a reason for retaining the original classification. The practical method of utilizing the results in his table, consists in finding contiguous sections of quartz and plagioclase which extinguish nearly parallel to one another. By means of the quartz wedge it is then determined whether the double refraction of these sections is of the same or of opposite sense. If the former, they are said to have parallel position and will indicate some of the relations of the first column of the table, and, if the latter, they have crossed position and their relations will correspond to something in the second column of the table. The quartz section always yields ω and a value varying but little from ϵ.

This method applies only to holocrystalline rocks which contain quartz, but it is a discovery of much importance which will doubtless be of much service in the study of the crystalline schists. The author has applied the method to the determination of the feldspar in many rocks of the Rosenbusch collection of B. Stürz, and printed his list of determinations. An excellent photogram also accompanies the paper.

Fluid Enclosures in Sicilian Gypsum.—The Cianciana gypsum contains cavities filled with liquid, some of which are 3 cm. in extent. Sjögren[15] has analyzed the liquid with the following results:

K_2O	Na_2O	CaO	MgO	Cl	SO_3	Total	O deducted for Cl_2	Cor. Total
2.1	40.9	4.1	3.9	44.9	14.1	110.0	10.1	99.9

Corresponding to

K_2SO_4	Na_2SO_4	$CaSO_4$	NaCl	$MgCl_2$	Total
3.7	11.4	9.7	66.2	9.0	100.0

The saline constituents were 4.023 per cent of the solution. This fluid is a fossil water of Miocene age, and differs from ocean water chiefly by containing a greater percentage of sulphates. It agrees fairly well with the water of some sulphur springs. The author thinks that the quantity of sulphates present in the water of the enclosure shows that the gypsum and sulphur cannot have been derived from a lagoon of sea water in which organic matters have reduced sulphur from the contained sulphates. Whether they are the product of sulphur springs or of emanations of H_2S in a lagoon of sea water in which sulphur has been deposited and sulphates formed by action of SO_2 on marls, the author is unable to determine.

[15] Bull. Geol. Inst. Upsala, I, (1893), No. 2, pp. 1-7.

New Sulphostannate from Bolivia.—In 1893 Penfield described a new isometric germanium mineral from Bolivia, which had the formula $Ag_8 Ge S_6$, and which he named canfieldite. This he showed to be identical chemically with Winkler's Freiberg mineral argyrodite, which that chemist had given the formula $Ag_6 Ge S_5$ and which Weisbach had considered monoclinic. Weisbach has since found that his earlier determination of the symmetry was incorrect, it being isometric tetrahedral and identical with the Bolivian mineral which should hence bear the name argyrodite. Penfield now transfers the name canfieldite[16] to a new sulphostannate of silver from La Paz, Bolivia, having isometric symmetry. A part of the tin is replaced by Germanium. The formula of the mineral is $Ag_8 (Sn Ge) S_6$, argyrodite being $Ag_8 Ge S_6$. The two minerals have similar physical properties, and are evidently isomorphous.

Allanite from Franklin Furnace.—Eakle[17] has made a crystallographical study of the allanite from the Trotter Mine, Franklin Furnace, N. J. The crystals occur in a granite dike associated with zinc ores. They are variable in habit and exhibit in all fourteen forms, none of which are, however, new to the species. The same author describes the tourmalines[18] from Rudeville and Franklin Furnace.

Miscellaneous.—Model[19] has found molybdenite and molybdite in the serpentine of the Rothenkopf, Zillerthal—. Carnot[20] has made an examination of the composition of wavellite and turquoise. In four analyses of wavellite from Cork, Ireland; Clomnel, Ireland; "Chester, Etats unis" (probably from Pennsylvania); and Garland, Arkansas, the fluorine was found to be 1.90, 2.79, 2.09 and 1.81 per cents respectively. Carnot proposes for the mineral the formula $2 (P_2O_5\ Al_2O_3)+Al_2\ (O_3F_6)+13\ H_2O$, but in the light of the recent work of Penfield, it seems more probable that part at least of the water present, is water of constitution, and that the fluorine replaces hydroxyl and not oxygen. In two specimens of turquoise of mineral origin (from Persia and Nevada respectively) no fluorine was found. Two specimens of occidental turquoise (odontolite) yielded each over three per cent of fluorine. The entrance of fluorine into odontolite during its derivation from fossil teeth, the author was led to expect from his study of the composition of fossil bones of the different geological ages.

[16] Am. Jour. Sci., [3], xlvii, pp. 451–4.

[17] Trans. N. Y. Acad. Sci., xiii, p. 102; also Am. Jour. Sci., [3] xlvii, pp. 436–8.

[18] Am. Jour. Sci., [3], xlvii, p. 439.

[19] Tscherm. min. u. petrog. Mitth., xiii, p. 532.

[20] Comptes rendus. cxviii, pp. 995–8.

GEOLOGY AND PALEONTOLOGY.

Origin of the Trilobites.—A study of the appendages of Trilobites leads Dr. Walcott to views confirmatory of those of Bernard in regard to the origin of the Trilobites. Dr. Walcott considers the modern Crustacea as "descendants of the Phyllopod branch, and the Trilobita form a distinct branch." (Geol. Mag., May, 1894).

Bernard's lastest communication on the subject, is to the effect that the great variability in the number of segments shown by Trilobites, the formation of the head by the gradual incorporation of trunk segments, the bending round ventrally of the first segment, the "wandering" of the eyes, the existence and modification of the "dorsal organ," and especially the character of the limbs, all serve to connect the Trilobites with *Apus*. That *Apus* lies low in the direct line from the original annelidan ancestor towards the modern Crustacea, and the Trilobites probably branched off laterally from this line, anterior to the primitive *Apus*, as forms specialized for creeping, with the protection of a hard imbricated carapace. This carapace resulted from the repetition on trunk segments of the pleurae of the head segments, which together form the head shield. (Proceeds. London Geol. Soc., March, 1894).

Some New Red Horizons.—A survey of Montgomery and Bucks Counties in Pennsylvania, has shown that the New Red in the former county is 27,000 feet thick. This unexpected result harmonizes with the recorded facts in other States. A study of this region has been made by Dr. B. Smith Lyman with the view of a better understanding of the relative geological position of the different horizons from which fossils have been reported in the "so-called American New Red" of the eastern part of the United States. Mr. Lyman recognizes in the Montgomery series five distinct horizons which he names and defines as follows, beginning with the oldest:

Shales mostly soft and red, but in small part dark gray or green, or blackish with beds of brown sandstone, and of gray sandstone and pebble rock, at Norristown and eastward, about 6,100 feet; Norristown Shales.

Shales, in great part hard, dark or greenish-gray and blackish, partly dark red, at the Gwynedd and Phœnixville tunnels, with traces of coal, about 3,500 feet; Gwynedd Shales.

Shales, mostly soft and red, at Lansdale and near it, about 4,700 feet; Lansdale Shales.

Shales, in great part hard and green, partly blackish and dark red, with some small traces of coal at the Perkasie tunnel and near it, about 2,000 feet; Perkasie Shales.

Shales, mostly soft and red, at Pottstown and northeastward, about 10,700 feet; Pottstown Shales.

The author then, from fossil records, traces these horizons in other Atlantic border States. In Maryland he finds the Gwynedd and Lansdale Shales represented. In Virginia, while the total New Red thickness is not so great as in Pennsylvania, there seems to be all five divisions represented. The North Carolina fossils all appear to belong to the Gwynedd Shales. In New Jersey the divisions are traced quite across the State with the exception of a dozen miles north, south and west of Somerville where the indications are not quite certain. In this State it is noticeable that the thickness of the New Red diminishes toward the northeast, and the variation is due to the absence of the upper beds, The diminution 'extends into Connecticut in greater degree, and still more so in Massachusetts. Almost all of the fossils in these two States represent the Gwynedd Shales. A list of all the recorded New Red fossils, arranged by the author according to the different horizons, facilitates comparison.

Mr. Lyman concludes his valuable contribution to geological literature with the following remarks:

"It is not improbable that the Norristown Shales, with the great calamite near Doylestown, the apparent Lepidodendron at Newark and Belleville, and the Palaeophycus at Portland, may after all prove to be at least as old as the Permian. It seems highly probable that the well ascertained great thickness of 27,000 feet in Montgomery County should represent more than one limited paleontological period, and not only that it should include the Permian, but that the very extensive upper third of that space, hitherto almost devoid of reported fossils, should turn out to be much newer than the Triassic. Those upper beds have also shown here and there imperfect fossil traces, and as there are occasional beds of green shale among the predominant red ones, there is reason to hope that more abundant and perfect fossils may some day be found."

As for the trap, the author thinks it impossible to doubt that all the conformable trap sheets are overflows contemporaneous with the sedimentary beds, and not subsequent intrusions. (Proceeds. Amer. Philos. Soc., Vol. XXXIII, 1894).

The Gosau Beds in the Austrian Salzkammergut.—The extensive literature of the Gosau Beds is a proof of their importance from a geological point of view. Since 1832 this remarkable formation with its unique fauna has been under discussion among European geologists. In a paper published in the Quart. Journ. Geol. Soc., 1894, Mr. H. Kynaston brings together the results of previous investigation on the stratigraphy and paleontology of the Gosau Beds, and gives an account of his own observations made with reference to fixing their geological horizon. The beds are divided into an upper and lower group, the latter extremely fossiliferous, while the former is almost devoid of organic remains. On both stratigraphical and paleontological evidence, the author correlates the Lower Gosau Beds with the Turonian and Senonian of the south of France. These in turn represent the English Middle and Upper Chalks. The Upper Gosau Beds being non-fossiliferous, cannot be located definitely, but the probability is that they represent the Danian of other districts and are on the same horizon as the chalk of Maastricht and Aix-la-Chapelle.

Geology of the Rocky Mountains between the Saskatchewan and Athabasca Rivers.—During the summers of 1892 and 1893, some explorations were made in the Rockies between Howse Pass and the Athabasca Pass. This tract of mountains, including some of the grandest mountain scenery in North America, has been neglected by scientific observers, so that maps hitherto published represent it incorrectly. New lakes and rivers were discovered, heights of peaks determined, and paleontological collections made. The results of a geological reconnaisance of this region are summarized as follows by Professor A. P. Coleman:

"To sum up the geological features of the region examined, we may describe the southeastern portion, well displayed along the Brazean River, as consisting of a series of seven or more minor ranges, each striking northwest and southeast, and tilted 25°–45° toward the coast line of the Pacific. These blocks, consisting of thousands of feet of quartzite and conglomerate, often overlain by thousands of feet of Devonian limestones, appear to have been thrown into their present attitudes by a series of reversed faults, as described by McConnell in Bow Pass. The rare folds observed in this portion of the mountains represent, perhaps, the dying out of such faults. Though no Cretaceous rocks have been proved to overlie the Devonian strata, it is probable that the faulting which produced the mountains took place

since Cretaceous times, for the foothills of Laramie sandstones give evidence of parallel faulting and tilting.

"On approaching the watershed of the Rockies west and northwest of the region just referred to, the regularity of the structure largely disappears. The direction and amount of dip vary, folds are not uncommon, and the rocks become more or less micaceous and metamorphosed; slates and sericite schists underlie the quartzites and conglomerates, and fossiliferous beds were not observed. The apparent absence of eruptive or plutonic rock is a feature worthy of note in a region where faulting has taken place on so huge a scale.

"The evidence of the action of Dr. G. M. Dawson's Cordilleran ice mass is distinct; the time which has elapsed since the Ice Age has been comparatively short, and the innumerable glaciers of the region represent the shrinking remnants of the ice sheet."

American Tertiary Aphidae.—It would hardly seem that plant-lice with their gauzy wings and soft bodies could be preserved in rocks. Yet they are not infrequently found. In Europe they are reported from four localities as well as from the Baltic amber. They have even been found in Mesozoic rocks. In America, Florissant, Colorado, has yielded 107 specimens, and they have been found at Green River, Wyoming, and Quesnel, B. C. The American Tertiary Aphidae have been described and figured by Dr. Scudder, and he has recently compiled a list of the species known, presenting them in a way to render their study comparatively easy and their diversity apparent. In the introduction he states that but one immature plant-louse has been found fossil in America, all the others are winged and belong to 32 species, divided into fifteen genera, of which 11 fall into the Aphidinae, the remaining four, with only five of the thirty-two species, into the Schizoneurinae, which have but a single branch to the cubital vein.

A characteristic feature of the American Tertiary Aphidae is a peculiarity in the neuration which is found also in the only wing known from the Mesozoic rocks. This feature is the great length and slenderness of the stigmatic cell. As a rule also the wings are long and narrow and the legs exceedingly short. Mr. Scudder calls attention also to the extraordinary variation in the neuration of the wings, which is strikingly greater than among living forms. (Thirteenth Ann. Rept. Director U. S. Geol. Surv. for 1891–92).

The Restoration of the Antillean Continent.—The following paper was read before the Brooklyn meeting of the Geological Society

of America. It is a difficult subject of unusual interest, and it promises to be epoch making in the department of dynamical and recent geology. Two previous papers by myself have been published by the Society upon topics leading up to the present investigations, which take into consideration the characteristices of the valleys both of the southern mountains and the coastal plains, and show how the valleys are directly due to atmospheric erosion. All of the land valleys become miles in width in their lower reaches, where they are buried by recent accumulations of sand, etc., to considerable depths. Off the coast there are broad submerged plateaus or terraces marking the pauses in the changes of sea level. Across these plateaus are numerous drowned *canons* or fjords shown to reach to very great depths. From their resemblance to the land valleys, they are regarded as of atmospheric or erosion origin, After passing the limits of the sands shifted by the coastal currents and filling the valleys, it may be said that every great valley has its fjord-like continuation through the submerged margin of the continental mass, even to depths of 10,000 or 12,000 ft. or more. From the natural inference that these valleys were formed above sea level, it would appear that the land had stood as high as the fjords are deep. But this statement is modified, for the movements have been in unequal undulations, the amount of which can often be calculated, and thereby the extreme depth has been reduced so that it seems that the former elevations of the West Indian region and adjacent parts of the continent may not have stood more than from 8,000 to 12,000 feet higher than now, according to the locality. The undulations of the earth's crust have been exaggerated by mountain folds in places, but in the great majority of the drowned valleys, such has not obtained for their direction is not parallel to the mountain ridges, but across that of the continental mass. Consequently there is no escape from the conclusion that the late continental elevation is measureable, but the movement has proved to be vastly greater than had hitherto been supposed, enough to change the whole physical geography of the region, the climate and the conditions of life. During the epochs of elevation, the Mexican Gulf and the Caribbean Sea were dry plains which extended to and were drained into the Pacific Ocean. The Antillean Islands formed a plateau-bridge connecting the two Americas.

At the close of the Miocene period, the Antillean and Central American lands were represented by only small islands. Then succeeded the Pliocene period during the earlier and mid portion of which the great elevation occurred. This was succeeded by the subsidence about the close of the Pliocene period, long enough to allow the

accumulation of the Matanzas limestones (of Spencer), but in amount not exceeding a depression of from 100 to 1300 feet below the present level. There was a late Miocene mammalian fauna on the continent, but it did not extend into the Pliocene period, for no mammals of that date are known east of the Mississippi River. As the fauna flourished when the continent was at about the same altitude as now, the great change in elevation, causing the subtropical climate to become subarctic, may have been sufficient reason for the restriction of the earlier life, whose descendants would have been extinguished by the drowning of the now insular region and 250,000 square miles of the continent. Again the continent rose to an altitude about as great as that of the Pliocene days, when it suffered an enormous erosion. During this earlier portion of the Pleistocene period, there was a rich mammalian fauna of horses, elephants, tapirs, camels, etc., but these were exterminated by the succeeding depression which carried down the Antillean lands to the proportions of small insular masses. and reduced the plains of the northern continent by 150,000 square miles. Since that time there have been reëlevations and minor undulations, but no connection between the islands and the continent, so that the modern types of mammals have been unable to reach the West Indies.

The changes which have occurred in the West Indies and those of the adjacent portion of the continent have been nearly identical, but the movements in the Antillies appear to have been somewhat more energetic, and the geographical evolution of the continent is best studied from the West Indian phenomena, but neither region is complete without the other. The general problem could not have been elucidated until the investigations which I have made upon the fjords.

The connection of the Antillean waters with the Atlantic and the separation from the Pacific Ocean should be noticed. There was free communication between the two oceans about the close of the Miocene period. The Pliocene union of the two continents separated the two oceans, although there may have been an enclosed sea between Cuba and Jamaica. With the subsidence of the land at the close of the Pliocene period, there was only a narrow and shallow communication between the Antillean waters and the Pacific, but the connection with the Atlantic was more complete than now. These connections were again closed during the Plistocene elevation. With the depression of mid-Plistocene days, the Atlantic was again admitted to the Mediterranean Seas, and it is also probable that there were two or three shallow passages leading to the Pacific. During the later Plistocene and modern days there have been no change of level which have effected

the oceanic connection. The changes of level have been of two characters; (*a*) the epeirogenic or continent-making movements, which produce broad but gentle undulations, depressing basins or raising up barriers, but not distorting the topographic features so as to render them unrecognizable, and (*b*) orogenic or mountain-making movements, which are most energetic over limited zones, and produce disfiguring barriers. Whilst the Antillean region was sinking with gentle undulations, the Central American mass was slowly rising, but it was farther deformed by the great mountain making movements and the late volcanic accumulations, which have completed the separation of the Antillean Seas and the Pacific Ocean.

The phenomena are extremely suggestive, and from the evidence brought out it appears that many problems of physical geology will need readjustment in the light of the changed continental condition, ocean currents, climate and distribution of life. The subject is important as a contribution to the structure of land features in their interpretation of geological history.

J. W. SPENCER.

The Drainage of the Great Lakes into the Mississippi River by way of Chicago.[1]—I now add another short chapter to the history of the Great Lakes. The highest beach south of Chicago is 45 feet above the lake and there are several beaches just above the present lake level. The divide between the lake and the Mississippi drainage is only eight feet above the lake, and this at a point 25 miles southwest of Chicago. The succession of beaches at the head of the lake has led to confusion, as there is an enormous lapse of time between, for the highest amongst the oldest shore lines of the later region from its level the lake shrinks to a plain 300 feet below, whilst the waters were being drained by way of the Huron Basin and the Ottawa River. Afterwards terrestrial deformation raised the northeastern river of the basins and turned the Huron waters into the Erie and Michigan basins, and for a time overflowed the Chicago divide, which became drained about 1500 years ago by the recession of Niagara Falls through Johnson Ridge. With the terrestrial deformation continuing as in the past, it is estimated that the drainage of all the upper lakes may be turned into the Mississippi in about 5000 or 6000 years.

J. W. SPENCER.

Geological News. GENERAL.—Professor T. C. Bonney calls attention to the possibility that a rock of igneous origin can be so

---

[1] Abstract of paper read before the American Assoc. Adv. Science.

changed by pressure and indirect consequences as to be readily mistaken for a compact and not very much altered sediment. He instances particular cases of schistose green rocks in the Alps which upon examination prove to be the result of crushing without shearing. The author suggests that modified igneous rocks may form a large part of the *Grüne Shiefer* of the Swiss geologists. (Quart. Journ. Geol. Soc., May, 1894).

ARCHEAN.—Evidence is presented by Mr. J. E. Spurr for correlating the Thompson slates, which occupy an extensive area in eastern Minnesota, with the Keewatin of the Mesabi Range rather than with the Animikie of that district. If the suggested correlation is correct, it will follow that the erosion interval between the Animikie and the Keweenawan was very great. (Am. Journ. Sci., Aug., 1894).

CENOZOIC.—M. L. Cayeux calls attention to the presence in the precambrian formations of Bretagne of Foraminifera of a relatively complex form associated with a large number of Radiolaria. The rocks which contain these organisms are quartzites and phtanites interstratified with the precambrians of Saint Lo. (Revue Scientif., 1894).

The discovery of certain fossil corals in Shasta and Siskiyou Counties in California, demonstrates the undoubted presence of middle Devonian deposits in that region. Notes on these fossils are given by Mr. Schuchert in Am. Journ. Sci., June, 1894, together with some correlations of the beds in which they were found with those of other regions. The Shasta County fossils are believed to indicate the Corniferous terrane as developed in New York, Kentucky, Michigan and Ontario. Those of Siskiyou County are of younger age, and agree in a few cases specifically with those of the Devonian of the White Pine Mining District in Nevada.

Mr. A. Smith Woodward records four new fossil fishes from the Karoo Formation. The descriptions are accompanied by plates showing the specimens natural size. Three of the fossils are Palaeoniscidae and the fourth belongs either to that family or to the Platysomidae. (Ann. Mag. Nat. Hist., 1893).

Newberry's genus, Spiraxis, is represented in the Devonian of Belgium. M. Stainer in describing this curious spiral fossil agrees with Newberry in supposing it to be the remains of a species of alga, and gives it the name *Spiraxis interstrialis.* (Bull. Soc. Belge de Geol. Pal.

et Hydrol., 1894). Dr. Hollick, however, shows that the bodies thus described are the casts of the spiral intestine of Cladodont sharks. (New York Acad. Sciences.)

MESOZOIC.—According to M. Lechien, the invertebrate fossils found in the bed from which the famous Ichthyosaur of Arlon was taken, indicate a formation belonging to the middle Lias instead of lower, as was at first supposed. (Bull. Soc. Geol. Bruxelles, 1894).

CENOZOIC.—The old theory first advanced by Shaler in 1870, of the origin of drumlins by a destructive process, that is, a working over of morainic or other drift deposits, have been revived by Prof. R. S. Tarr. He brings forward facts to support it, and discusses three objections to it, but concludes on the whole that this theory forms a good working hypothesis, even if it is not accepted as the most probable theory. (Am. Geol., June, 1894).

Mr. Warren Upham offers, as an explanation of the Plistocene climatic changes, the epeirogenic theory of the Ice age thought out and formulated by Dana, Le Conte, Wright, Upham and Jamieson. He conceives the Ice age to have been essentially one and continuous, with important fluctuations. Soundings off the West African Coast record a submerged channel of the Congo extending eighty miles into the ocean to a depth of more than 6,000 feet. Another deep submarine valley having soundings of 2,700 feet is known on the African Coast 350 miles north of the equator, and there is a similar valley in the southern part of the Bay of Biscay. These remarkable valleys beneath the sea level indicate that probably the entire Atlantic side of the Eastern Continent has been greatly uplifted within late geologic time. (Geol. Mag., Aug., 1894).

In regard to the "Black Earth" of Russia, Dr. W. F. Hume suggests (1) the position of Loess has been determined by the manner and conditions of its origin, and (2) Black Earth is merely a special closing feature in the sequence of a long history of Loess, and it is merely that deposit rich in humus resulting from the decomposition through long ages, of generations of grasses and steppe plants. (Geol. Mag., Aug., 1894).

The Yellow Gravel of New Jersey is made the subject of special discussion in the report of Prof. Salisbury upon the surface geology of that State. After giving its distribution and its history as inferred

from its character and position, the author states that the study of this formation leads to the following conclusions:

(1) The original yellow gravel is Pre-plistocene. (2) The time of its deposition was followed by an epoch of elevation and extensive erosion of long duration. (3) Then came a period of depression during which the Columbia deposits were made, equivalent in age with the first glacial deposits. (4) Again an epoch of elevation and erosion, when the degradation and redistribution of the original formation went forward. (5) An epoch of slight depression. (6) Subsequent elevation to the extent of forty to sixty feet, followed by the present subsidence. (Ann. Rept. Geol. Surv. New Jersey for 1892).

ZOOLOGY.

Parthenogenesis among the Acari of Feathers.—In a communciation to the Entomological Society of France, Dr. Trouessart states that he has observed a parthogenetic manner of reproduction in the plumicolous Sarcoptidæ under such conditions as to preclude the possibility of mistake. In 1888 Dr. Trouessart described an Acarian, *Syringobia chelopus*, which is found in the tubes of the feathers of *Totanus calidris*, a bird of passage through France in the Spring and Fall. A study of the life history of this species has developed the following facts.

In the Spring little colonies of the Acarian are found in the tubes of the feathers of the migrating wader, evidently having wintered in those narrow quarters feeding on the pith of the feather. Their numbers are small rarely exceeding ten or twelve in each colony. The composition of the colonies is variable, but taking 25 or 30 of the principal feathers of the wing together there will be found the following eleven forms. (1) Eggs with a shell; (2) Naked eggs; (3) Normal larvæ; (4) Abnormal larvæ; (5) Normal nymphs; (6) Abnormal nymphs; (6) Sexually developed females or secondary nymphs; (9) Abnormal females; (10) Normal males or *heteromorphs;* (11) Abnormal males or *homeomorphs.* All of the forms are not found together in the same feather. The normal form and the abnormal form (which I have called *syringobia*) live in separate feathers, and the naked egg belongs to the latter form. The males in the abnormal series are very râre, only one or two for one hundred females in that series; while in the normal series the proportion is one male to three females. Neither normal males or eggs with a shell are found with the syringobial females. These lay naked eggs covered only with the thin hyaline membrane which forms the inner covering of the shelled eggs.

In a general way the syringobial form, is distinguished from the normal by its large cheliceres and by the thin, transparent skin over the posterior part of the body. The syringobial female is larger and more elongate than the normal type.

The skin left after the final moult, which transforms the syringobial nymph into an adult female, is totally wanting in the post-anal opening which corresponds to the copulatory pouch and which is perfectly plain in the secondary normal nymph or sexually developed female.

The life-history as traced by Dr. Trouessart proceeds as follows:

At the time of the autumn moult which preceeds the departure of the birds for the warm countries a certain number of young larvæ or nymphs of *Syringobia* penetrate the tube of the feather through the *ombilic supérieur.* Three or four are thus installed in each feather. If there is one or more males in the colony the development is normal, and the fertilized females lay shelled eggs. On the contrary, if there are no males, the female nymphs having attained the age of the secondary nymph, instead of being transformed into normal females continue growing until the body is nearly double the size of the normal secondary females, assuming more and more the characters of the syringobial form; then they undergo a final moult and are transformed into parthenogenic females laying eggs without shells. From these eggs are developed larvæ, which reproduce the parthenogenetic form during the migration of the bird. At the end of the journey, either immediately or during the stay in the warm region, the young issue from the two series (the normal egg and the parthenogenic egg), leave the interior of the feather and make their home on the plumage. In fact, Syringobia is found on the plumage of birds killed in the warm countries, but they are found in the feather only during migration.

Parthenogenesis, in this case, according to Dr. Trouessart is the result of the segregation of individuals and the death of males. It is probable that this phenomenon is more frequent in this group than has been hitherto supposed. (Bull. Soc. Entomol. Paris, 1894.)

Trionyches in the Delaware drainage.—Turtles of this family have been supposed to be absent from the Delaware drainage, but the two following instances show that this view is no longer tenable. In the latter part of August a specimen of the "soft shelled turtle" was captured in the Paulins Kill at Hainesburg, Warren, Co., N. J. and sent to the museum of the Wagner Institute by Mr. E. B. Allen. The mounted specimen measures as follows: Total length 18 inches. Length of carapace 12 inches, width 9 inches. Length of plastron 8 inches. The tough integument has shrunken somewhat and its true measurements exceeds these by about one inch. Color a dark brown, with black spots, many of these ocellate, under surface white, feet dark yellow irregularly marked with black.—CHAS. W. JOHNSON.

NOTE ON THE ABOVE—Two individual Trionychidæ were captured in a pond near Woodbury, N. J. about a year ago, and are now living in captivity. I have not seen them, but there is no doubt as to the fact.—E. D. COPE.

The Femoral Gland of Ornithorhynchus and Its Secretions.—At the July meeting of the Linnean Soc. N. S. W. a paper on the secretions of the femoral gland of the Ornithorhynchus was presented by C. J. Martin and F. Fidswell. The paper contained also notes of an experimental enquiry concerning the toxic action of these secretions.

The gland is described as belonging to the compound racemous variety with large alveoli possessing a wide lumen, and somewhat recalling the appearance of a mammary gland. The alveoli communicate with ducts which eventually join at the hilus of the gland to form the duct leading to the spur.

The gland is surrounded by a capsule of fibrous tissue, exterior to which is a thin layer of smooth muscle fibres. A marked difference in the minute structure of the gland was noted in animals killed in June and those in April respectively, the former showing the appearance characteristic of an actively secreting gland, whereas the latter suggested that of a mammary gland when it had undergone retrogressive metamorphosis.

Examination of the poison showed it to consist principally of albuminous bodies, and the introduction of these into rabbits produced very marked poisonous results. When injected under the skin, local swelling and general depression and rise of temperature followed, but in three days the animal was well again. When the poison was introduced directly into the vascular system, small quantities (⅛ grain) caused death in under half an hour. Larger doses so introduced produced almost immediate death, by producing nearly universal clotting of the blood whilst travelling in the blood vessels. Such clotting naturally soon put an end to all circulation.

In summing up, the authors compare the action of Ornithorhynchus poison with that of the venous of Australian snakes, supposing the latter to be diluted 5000 times. (Nature, Sept,, 1894.)

Change of Color in the Northern Hare.—From the study of 75 specimens of *Lepus americanus* collected for the express purpose of investigating the seasonal change of color, Mr. J. A. Allen arrives at the following conclusions:

(1) The change of color, both in autumn and in the spring, is due to change of pelage, and not to a change in the hair itself.

(2) The change is gradual, occupying many weeks.

(3) The method of change, as regards the parts first affected is the reverse in spring in the order characterizing the autumnal change.

(4) In the early part of spring, after the white overhair has been shed, the pelage consists of the heavy coat of soft winter underfur. This gradually disappears as the summer coat thickens.

(5) In spring the moult occurs quite as early and proceeds just as rapidly in the females as in the males, and the moult is practically completed before the young are born.

These conclusions differ widely from views hitherto entertained by both scientific and non-scientific writers. (Bull. Amer. Mus. Nat. Hist., 1894.)

Zoological News. MOLLUSCA.—The characters in the shell of *Nautilus pompilius*, described as sexual by J. Van der Hoeven, are believed by Messrs. Bather and Buckman to be due to age rather than to sex. In that case a strong point in favor of sexual dimorphism in Ammonite shells has lost its value. (Nat. Sci., Vol. VI, 1894.)

In a discussion of the geographic and hypsometic distribution of North American Viviparidæ, Mr. E. Call recognizes four genera, viz., Tulotoma, with two species; Lioplax, with two species; Vivipara, with four species; and Campeloma, with nine species. This arrangement is based upon the examination of several thousand specimens. Of these species, *Campeloma decisum* Say has the widest range and *Vivipara troostiana* the most restricted. The latter is abundant in a small stream near Murfreesboro, Tennessee, and there is no record of its being found elsewhere. Vertically, the most of the species lie between 100 and 700 feet altitude. Here again *Campeloma decisum* has the greatest range. (Am. Jur. Sci., Vol. XLVIII, 1894.)

CRUSTACEA.—A new species of Tanais (*T. robustus*) is described by Mr. H. F. Moore. It inhabits minute tubes in the crevices between the scales of the carapace of *Thalassochelys caretta.* (Proceeds. Phila. Acad. Sci., 1894).

A blind cray-fish from Florida is described by Dr. Lönnberg under the name *Cambarus acherontis.* The specimens we obtained from a subterranean rivulet struck about 30 feet below the surface of the ground in Orange County. They represent the fourth species of Cambarus found in the United States. (Zool. Anz., 1894.)

VERTEBRATA.—Dr. Boulenger describes 13 new species of freshwater fishes from Borneo. They are referred to 9 genera of which one, Nematabramis, is new. Three species, *Nemachilus olivaceus*, *N. saravacensis* and an *Acanthophthalmus* are of special interest as the first Cobitines described from Borneo. (Ann. Mag. Nat. Hist., Vol. XIII, 1894.)

Prof. E. D. Cope has recently published a paper on Reptiles and Batrachians from Costa Rica in which he enumerates fifteen new species, distributed as follows; 1 Urodela, 4 Salientia, 3 Lacertilia, and 7 Ophidia. Among them are two new genera; Levirana, identical with Ranula, but without vomerine teeth, and Pogonaspis, more nearly allied to Tantilla than to any other genus, but differs from it in the large single genial plate. (Proceeds., Phila. Acad., 1894.)

A preliminary list of the Reptiles and Batrachians of the Island of Trinidad prepared by Messrs. Mole and Urich shows a total of 76 species distributed as follows: Tortoises 6; Lizards 25; Snakes 33, Batrachians 12. Of these species 21 are recorded for the first time from the Island and two are new to science. The latter are described by Boettger under the names *Sphærodactylus molei* and *Hylodes urichii* (Journ. Trinidad Field Naturl. Club.)

A small collection of reptiles and fishes from Lake Tanganyika examined by Dr. Gunther includes a new genus of snakes, Glypholycus, of which one species only is described, *G. bicolor*. Two new species of Mastacembelus which appear to connect the Asiatic species with the West African, and three species referred to Chromis. (Proceeds. London Zool. Soc., Nov., 1893.)

According to Dr. Shufeldt the fibula in many birds is complete, normally reaching the ankle-joint. He cites as examples in the Steganopodes, the Snake-bird *Plotus anhinga*, *Phalacrocorax bicristatus* (almost complete), *Sula piscator*, *S. cyanops*, *S. bassana*, *S. gossii* and *Fregata aquila*. Judging from the literature upon the subject, this fact concerning avian anatomy is not generally known. (The Ibis, July, 1894.)

Among the mammals of Baltistan and the Vale of Kashmir, presented to the U. S. Natl. Mus. by Dr. W. L. Abbott, are three species of Arvicola, *A. fertilis*, *A. montosa* and *A. albicanda*, which are new, and also a new geographical race of *Mus arianus*. *Sminthus concolor* in this collection extends the range of that species a thousand miles. (True in Proceeds. U. S. Natl. Mus. Vol. XVII, 1894.)

In his studies of North American Mammals Mr. F. W. True finds it necesssary to place Brewer's mole in a new genus, Parascalops. In the same paper are given diagnoses of an undescribed race of Albert's squirrel, *S. aberti concolor*, a new lemming, *Myodes nigripes*, and a lemming-like mouse, representing a new genus, *Mictomys innuitus*. (Proceeds. U. S. Natl. Mus., 1894.)

ENTOMOLOGY.[1]

North Ameridan Ceutophili.—This interesting group of wingless locustarians has been monngraphed in a very satisfactory manner by Mr. S. H. Scudder.[1] "With the exception of the genus Troglophilus Krauss, with two species from European caverns, and the genus Talitropis Bol., with a single species from New Zealand, placed respectively at one and the other end of the series, they are known only from America; and with the further exception of Heteromallus Brunner, with two species from Chili, they are all peculiar to the United States and Northern Mexico. Here they include six genera and sixty-seven species, the genus Ceutophilus alone containing above fifty species. The larger proportion of them, if not all (excepting *Udeopsylla nigra*) frequent dark places, such as burrows, pits, caverns, wells, hollow trees, and especially the crevices beneath fallen logs." Thirty-eight new species are characterized in the present paper, in which the treatment, except for the absence of illustrations, is all that could be desired.

The Plume Moths.—A study of the biological relations of the earlier stages of the plume months convinces J. W. Tutt[3] that these insects belong to two distinct families, the Pterophorina and the Alucitina. The latter (called Orneodinæ by Fernald and others) "belong to the Pyraloid section of the Obtectæ, the larva of which has a complete circle of hooks to the ventral prolegs, and the pupa of which is smooth and rounded, laterally solid, inner dissepiments flimsy. The free segments in both sexes are the fifth and sixth abdominal.

"The Pterophorina belong to the Incompletæ and have no affinities with Alucitina. Both groups have under the same or similar necessities developed plume wings and this is the only connection. The pupa is attached by a cremaster, less solid and rounded, appendages often partially free. Free segments may extend up to the third abdominal."

In emphasizing the necessity of biological studies in classification, Mr. Tutt quotes with approval, the recent dictum of W. H. Edwards: "There never will be a final authoritative revision of any genus of butterflies till the preparatory stages in every species of it are known."

---

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2]Proceedings Amer. Acad., VXXX, pp. 17-113.

[3]Ent. News, V, 209.

New Use for Bisulphide of Carbon.—Professor J. B Smith acting on the suggestion of Professor H. Garman finds by experiment that bisulphide of carbon can be used to advantage against aphides on plants above ground. By covering infested melon vines with a tub or other closed vessel, and allowing a drachm of bisulphide to evaporate in a shallow dish beneath it, the pests were killed at the end of one hour. The coverings were then removed.

Mimicry in Diptera.—Mr. C. J. Wainwright reports[4] interesting observations on mimicry of Diptera flying in England in early spring. Two species of the Syrphid genus Cheilosia so resembled bees of the genus Andrena as to make it very difficult to distinguish them. "They particularly resembled *Andrena fulva,* and we netted far more of the bee than of the Dipteron in our efforts to get the latter. The resemblance is very strong, color, size, and (to a considerable extent) shape being much the same; when at rest on a flower the Dipteron curls its body under a little as the bee does, and folds its wings over its back in the same manner."

There was also present a species of Echinomyia of the family Tachinidæ, which had a bee-like appearance, differing in this respect from other members of its genus. "It, however, resembled no species in particular; it bore a general resemblance to *Bombus muscorum* in size, shape and color, but it was not so hairy and did not fold its wings bee fashion."

In commenting on these observations Mr. Wainwright says: "There is very little doubt that in the spring, when insects are not very numerous, and when, therefore, we may reasonably infer that their enemies are unusually alert in discovering and capturing them, that it must be even more necessary than during the summer, for those insects which do appear, to be well protected in some way from their foes, and especially if they happen to be species which, through feeble reproductive powers or other similar causes, are limited in numbers to commence with. Now, the two Cheilosiae are distinctly species which are limited in numbers, in fact, they are somewhat rare species, and may be described as occurring singly; they are not robust species, in fact, rather the reverse, and, therefore, they are just such species one would expect to find protected by mimetic resemblances. In every way they may be said to present all requirements of an ordinary case of mimicry.

"The Echinomyia, however, does not present so ordinary a case. It is a wonderfully strong and robust species, belonging to a group of

---

[4] Ent. Monthly Magazine.

parasitic species, all of which are strong and robust, and ordinarily neither need nor possess any such protection as a mimetic resemblance. It is well protected on the body by strong hairs, answering, to some extent, the purpose of spines, and is very strong on the wing; it is very large, too, many specimens being 8 or 9 lines long. It, however, occurs at this time (March) when other insects are scarce, and it must be conspicuous and so tempt its foes, and although common on this particular occasion at Wyre Forest, I do not think it is usually a common species, at least, I never saw it before; altogether, although it does not answer the usual requirements of a mimetic species, yet there are obviously good reasons why a resemblance to the strong and usually unmolested Bombi would be an advantage to it. We accordingly find that it does possess some such resemblance, though imperfect, and it is just this imperfection which is its most interesting feature, and it is to some extent the reason for these notes.

"Many or all of the opponents of the theory of mimicry urge very strongly the difficult question, how does the resemblance arise? In early stages it can be of no use to its possessor. But here, I think, we have a case showing how mimicry may arise, and even the early stages be of use. The Tachinidæ do not, as a rule, resemble in the least degree any Hymenoptera, they are quite unlike bees. The Echinomyia are a genus of unusually large and well developed Tachinids, some of which (fera and ferax for example) are simply ordinary Tachinids in appearance, though unusually large, and quite unlike bees; they are summer species; Ursina, however, a spring species, though closely allied to these others by a comparatively slight alteration in color, a development rather than an alteration, and the increase of its hairs in number and size, at once and unexpectedly somewhat resembles *Bombus muscorum*, and almost certainly must derive some protection from even this superficial resemblance, at a time when food is being so eagerly sought by insect foes. It only needs a still further increase in hairiness, and to fold its wings over its body, and it would be an almost perfect mimic; and supposing its nearest allies to be lost, we should wonder how the early stages arose."

Description of a New Pelecinus from Tennessee.—The genus *Pelecinus* forms a peculiar family allied to the Proctotrupidæ, in the Antigynea, among the highest Aculeate hymenoptera. The costal vein in rare instances is not developed, showing a transition to the higher non-aculeate monotrocha or Hymenoptera minuta. The larval habits are unknown, although the imago has been observed issuing

from the ground and locust eggs are possibly its food. The discovery of a new species is therefore of interest.

The antennæ are fourteen-jointed in both sexes, those of the male longer. The mandibles, armed with a tooth near the apex within, and the labial palpi show no sexual difference. The maxillary palpi, long in the female, are not visible in the male. The middle and the hind tibiæ are two-spurred in both sexes; the hind tibiæ greatly swollen in the female, are no more swollen than the femora in the male. The first joint of the hind tarsi in both sexes is as short as the last joint.

The abdomen of the female is elongate, cylindric, six-jointed, with a seventh dorsal joint connate with the sixth; sting minute; the abdomen of the male is cup-shaped, likewise six-jointed; claspers directed forwards beneath. In the male abdomen the first segment is three times as long as all the rest combined, gradually enlarged towards the extremity; the third and fourth segments are longer above than beneath; the fifth and sixth segments are vertical, invisible from above.

PELECINUS BRUNNEIPES, n. sp.

Female.—Size of *dichrous.* Disc of propodeum behind puncto-reticulate. An oblong brown cloud in the first submarginal cell behind the stigmal cloud. Legs piceous-brown; middle and fore tibiæ and tarsi clay-yellow. Tenth and apical half of ninth joints of atennæ whitish. The whole insect otherwise shiny black.—One specimen collected at Marysville by Prof. E. M. Aaron.

In *P. polycerator*, which is of larger size, the disc of propodeum behind is transversely arcuately rugose, the depressions punctate; there is no separate cloud in the wing; and the legs, except tarsi, are entirely black.

PELECINUS DICHROUS Klug.

Specimens of this South American species, kindly sent me by Prof. Carl Berg, of Buenos Ayres, show the disc of the propodeum behind transversely rugose in the female and longitudinally rugose in the male. The female has the ocellar tubercle, the clypeus, a spot above clypeus, a spot at base of mandibles, the thorax (especially above) red; the legs more or less brownish; the tenth joint and apex of ninth joint and base of eleventh joint of antennæ orange. The male has none of the red shown in the female and the atennæ are entirely black.

WM. HAMPTON PATTON.

Flight of Locusts.—Mr. C. B. Mitford gives an interesting account[5] of what was, he says, a more marvellous sight than any he has ever

seen. The changed appearance of the "bush" at Freetown, Sierra Leone, on the 25th of November, 1893, led him to call the attention of a native, who told him that locusts were coming. In a short time huge black clouds appeared above the hills, and these first seen gave the idea that the whole of the sides of the hills, three miles off, were on fire; at 2.45 p. m. these supposed clouds reached Freetown and proved to be a continuous mass of locusts, which passed without intermission till 5.10 p. m. Myriads settled, but made no apparent difference in the size of the swarms. The whole town was covered with their excrement. At 9.45 a. m. the next day the stream began again, but not in such dense masses, and continued up to 1 p. m. The species has been found to be *Pachytylus migratoroides* originally described from Abyssinia.—*Journal Royal Microscopical Society.*

---

[8] Proc. Zool. Soc. Lond., 1894, p. 2.

PSYCHOLOGY.

The Habit of Amusement in the Lower Animals.—In some former papers which have already been published in this journal and elsewhere, I have shown that animals exceedingly low in the scale of animal life possess the five senses, sight, smell, taste, hearing, and touch, or senses akin to them; also that these animals evince a high degree of intelligence.[1] One would naturally expect to find in animals biologically so akin to man, some evidences of enjoyment other than the mere gratification of animal desires. This expectation or surmise is undoubtedly correct, and it is the purpose of this article to demonstrate this truth. We are all familiar with the pastimes of the higher animals such as the dog, the cat, the horse, the squirrel, the rabbit, the monkey, etc. We do not question the fact that these animals do amuse themselves in many a frolic and wild romp; they form a part and parcel of our lives, consequently their pastimes are not considered remarkable. I propose, however, to show that animals much lower in the scale of life—animals so low and so minute that it takes a very high-power lens to make them visible, likewise have their pastimes and amusements. Also, that many insects and even the slothful snail are not so busily engaged in the struggle for existence that they can not spare a few moments for play. In our researches in this field of animal intelligence we must not attribute the peculiar actions of the males in many species of animals when courting the females, to simple pastime, for they are the outward manifestations of sexual desire, and are not examples of psychical amusement. I have seen, in actinophorous rhizopods, certain actions, unconnected with sexual desire or the gratification of appetite, which lead me to believe that these minute microscopic organisms have their pastimes and moments of simple amusement. On several occasions while observing these creatures, I have seen them chasing one another around and around their minature sea. They seemed to be engaged in a game of tag. This actinophrys is not very agile, but when excited by its play, it seems to be an entirely different creature, so lively does it become. These actions were not

---

[1] North American Review: "The Senses in the Lower Animals."
American Naturalist: "Animal Intelligence."
Atlantic Mónthly, Contrib. Club: "Animal Letisimulants."
Worthington's Magazine: "The Emotions in the Lower Animals."

those of strife, for first one and then another would act the pursuer and the pursued. There were, generally, four or five actinophryans in the game. One of the rotifers frequently acts as if engaged in play. On several occasions I have observed them perform a kind of dance, a *pas seul*, for each rotifer would be alone by itself. Their motions were up and down as if exercising with an invisible skipping-rope. They would keep up this play for several minutes and then resume feeding or quietly remain at rest. This rotifer goes through another performance which I also believe to be simply a pastime. Its tail is armed with a double hook or forceps. It attaches itself to a piece of alga or other substance by this forceps, and then moves its body up and down in the water for several minutes at a time. The snail (*H. pomatia*) likewise has its moments of relaxation and amusement. The following instance of play may be considered to be gallantry by some, but I do not believe that I am mistaken, however, when I consider it an example of animal pastime. Two snails approproached each other, and, when immediately opposite, began slowly to wave their heads from side to side. They then bowed slightly several times in courtly salutation. This performance they kept up for quite a while and then moved away in different directions. At no time did they come in contact, and careful observation failed to reveal any excitement in the genitalia. I have witnessed the embraces of snails, and the performance described above does not resemble in the slightest degree, the manoeuvres executed at such times by mating individuals.

Swarms of Diptera may be seen on any bright day dancing in the sunlight. Naturalists have heretofore considered this swarming to be a mating of the two sexes. This is not the case, however, in many instances. On numerous occasions, and at different seasons of the year, I have captured dozens of these insects in my net and have examined them microscopically. I found them all to be unimpregnated females; I have never yet discovered a male among them. In some of the Diptera the males emerge from the pupa state after the females; I therefore believe that the females await the presence of the males, and, while waiting, pass the time away in aerial gambols.

Forel, Lubbock, Kirby, Spence and other naturalists have declared that ants, on certain occasions, indulge in pastimes and amusements. Huber says that he saw a colony of *pratensis*, one fine day, " assembled on the surface of their nest, and behaving in a way that he could only explain as simulating festival sports or other games." On the 27th of last September, the males aud females of a colony of *Lasius flavus* emerged from their nest; I saw these young kings and queens con-

gregate about the entrances of the nest and engage in playful antics until driven away by the workers. The workers would nip their legs with their mandibles until they were forced to fly in order to escape being bitten. On the 19th of this month (July) I saw several *Lasius niger* come out of their nest accompanied by a minute little beetle (*Claviger foveolatus*); the ants caressed and played with this little insect for some time, and then conducted it back into the nest. Many little animals are kept by ants simply as pets. Lubbock says of one of them, a species allied to *Podura*, and for which he proposes the name, *Beckia*. "It is an active, bustling little being, and I have kept hundreds, I may say thousands, in my nests. They run in and out among the ants, keeping their antennæ in a perpetual state of vibration." I have frequently noticed an insect belonging to the same species as the above, in the nests of *F. fusca* and *rufescens*. They reminded me very much of the important-looking little dogs one sees running about in the midst of a crowd on market-day. In the November issue of the Naturalist, I describe a spider which indulges in a peculiar pastime. This spider spins a web where the rays of the early morning sun strike. Through the long diameter of the web, she spins a narrow ribbon, and, as soon as the sun shines upon it, she goes out on this ribbon and promenades up and down. She never takes food caught in this web; her hunting- or trap-web is generally several feet away, but connected with her pleasure resort by a bridge.

Sometime ago I witnessed a bit of malicious sport, in which, the participants were fleas. I was observing a *Pulex* sleeping beneath the short hairs of a dog's axilla. My lens was a good one and I could clearly make out the body and limbs of the little sleeper. Suddenly there appeared another flea, which stopped short as soon as she discovered her sleeping comrade. She remained quiet for several seconds and then nimbly bounded on the others back. Clasping her body with her hind legs, she began vigorously "to touzle the hair" of her surprised sister. She then sprang away into the thicker hair, closely pursued by the thoroughly aroused and evidently angry victim of her sport.

The females of the coleopterous *Coccinellæ* frequently congregate and indulge in performances that can not be anything else save pastimes. A beech tree in my yard is called "ladybug tree" because, year after year, these insects collect there and hold their curious conventions. They caress one another with their antennæ, and gently shoulder one another from side to side. Sometimes several will get their heads together and seem by their actions to be holding a confidential conversation. These conventions always take place after

oviposition, and careful and repeated observation has shown me that they are not connected with procreation or alimentation. I have witnessed many other instances of true psychical amusement in the lower animals but do not think it necessary to detail them here. Suffice it to say, that I believe that every living creature, at some period of its existence, has its moments of relaxation from the cares of life when it enjoys the gratification of true psychical amusement.—JAS. WEIR, JUN., M. D.

ARCHEOLOGY AND ETHNOLOGY.[1]

Dr. Brinton on the Beginning of Man.[2]—Dr. Brinton contributes a characteristically readable and inconsistent article to the *Forum* on this subject, which is the most important and interesting among the many presented by the science of biology. It is also at the same time a prime question among archeologists, but as the archeological materials do not lend themselves to its solution, the cultivators of that science have not generally devoted much time to its investigation. Archeology begins, as Dr. Brinton says, with the evidence of human industry; that is, it begins after man had become man, and not before. It, therefore, commences where paleontologic biology leaves off, and does not embrace the question of his ancestry, which belongs to the latter science. Nevertheless, Dr. Brinton, well known as a distinguished archeologist, discusses the question of the ape-ancestry of man in an entertaining, and to some extent, instructive manner. But I have some fault to find with his article from a biological standpoint, and as it is calculated to encourage some popular prejudices, I propose to state them.

First there is to be noticed throughout, the flavor of Virchoffism, which has been so vigorously exploited by Haeckel. Virchow appears to be unalterably opposed to the hypothesis of the ape-ancestry of man, and he uses frequent opportunities of casting ridicule on it. He even goes so far as to ignore, when convenient to his argument, such evidence as there is in support of it, in a way which does not impress me with his capacity for fairness. His conspicuous fallacy is his neglect of the biological evidence for the doctrine of creation of organic species by descent, so far as regards man. This is so overwhelming, that biologists are a unit in believing in it. Man cannot be excluded, for his zoological affinities with the anthropoid apes are most pronounced. Man is not an example of an isolated type, of which many can be found among animals and plants, but his relatives are conspicuously close to him in structure, so that if evolution is true, man is one of the most evident illustrations of it. Yet Brinton says "a dozen years ago when Darwinism was at its height, an advanced scientific thinker would have felt compelled to maintain that the species man was necessarily a de-

---

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

[2] The Beginning of Man and the Age of the Race by Dr. D. G. Brinton; *The Forum*, Dec., 1893, p. 452.

velopment of some lower mammal." I do not hesitate to say that Darwinism (i. e. evolution) was never at a greater "height" than it is at present. It is also highly uncomplimentary to the "scientific thinker" to charge him with holding views on account of the "height" of any opinion, rather than on the evidence.

The type of man of the paleolithic age, is stated by Brinton to be a fiction which "furnished imaginative writers with the compound creature they pictured in their books as our common ancestor," etc. He then proceeds to discredit this "compound" by showing that some mistakes were made by some investigators in some points, although when he says that that the Neanderthal remains belong to a visibly diseased subject, he asserts more than has been proven. He also alleges that the depressed forehead and prominent superciliary ridges of various paleolithic skulls that have been discovered, are no indication of pithecoid origin, since they can be found occasionally among men of existing races! An argument of no value whatever, since if all low types necessarily disappeared, man would be the only animal; no monkeys ought to exist; no insects, no Amoebas! Evolution does not attempt to prove that nothing has stood still! But our author has nothing to say about the jaws of Naulette and Shipka, and the man and woman of Spy. It is on just these important remains that Virchow is silent also!

But he does have something to say on the tritubercular superior molar[3] and the lemuroid affinities of the Anthopomorpha (man and ape). Referring to the author of the present review, he says: "An eminent naturalist discovered that in a considerable number of people the tubercles on the teeth resemble those of lemurs more closely than those of monkeys. Hence he promptly drew the conclusion that the descent of man was directly from the lemurs and not from the monkeys, as the prevailing impression has been." Dr. Brinton has advanced in his views a little. He at one time declared that this statement as to the structure of the molar teeth in the higher as compared with the lower races and the apes had been "refuted" by Allen and Virchow. Soon after this, my statements were entirely confirmed by Topinard, who after a full examination of six hundred dentitions de-

---

[3] The reviewer of my paper in the April, '93 Naturalist on The Genealogy of Man, says of the tritubercular molar, that it is only the long known "microdontie" of civilized races. (Archiv. für Anthropologie, 1893). The reviewer evidently does not know what the tritubercular molar is nor what it signifies. It is not necessarily microdont, nor is it confined to civilized man. He has evidently not read my paper on the subject or he would not have remarked that I give no figures as to its predominant occurrence in the Esquimaux. (See Am. Journ. Morphology, July, 1888).

clared that man from having had four tubercles above and five below, would in some distant future have three above and four below. But he added that the theory of descent from lemurs is "not sustained" or "is premature." This latter question is one for paleontological biologists to decide, and Prof. Topinard did not even discuss the evidence from this standpoint. There is, however, good reason to suppose that the anthopoids (not man only) did descend from lemuroids and not from monkeys. Since Dr. Brinton's article was written, Dr. Forsyth Major has described an extinct *plistocene* lemur from Madagascar nearly as large as a chimpanzee, with tritubercular superior molars. I look for future discoveries to demonstrate the truth of the lemurine descent of the Anthropoids, and that the monkeys (Ceropithecidae) are a side branch and not in the direct line.

The descent of man from the Anthopoids is antagonized by Virchow because some of the pithecoid characters of man are not prenatal, but only appear in later growth stages and cannot therefore be inherited. And if he can find a mechanical cause for the character, so much the more certain is this conclusion in his opinion. An example of this is the ape-character found among various men ancient and modern, the platycnemic or compressed tibia. This Virchow alleges is not a mark of affinity to the apes, where it is universal, but that it is produced by a peculiar use of the muscles of the lower leg, especially of the anterior ones. This, however, only transfers the evidence from the bones to the muscles. The tibial form of the apes, it may be inferred, is produced in the same way as in man, and if it is so produced in men, we learn that in such cases the muscles and their use are like those of the apes. Prof. Virchow does not probably know, that if inheritance be believed, the entire osseous skeleton of the vertebrata has been moulded by the strains, pressures and impacts to which it has been subjected, and that these are directly or indirectly due to muscular contraction. The supposition that prognathism is not inherited from apes because it is not present in the foetus, is equally untenable. The change of shape of the relations of the cranial bones called prognathison, is common to all vertebrata, and is only delayed, more in apes, most in man.

But Dr Brinton, like many other objectors to evidence of a plain and unadorned character, has his *Deus ex machina.* "Genius is ever inexplicable" he says. True; but the shapes of bones and teeth are not, and the brains of the genius contain the structural reasons for their functions, although we have not yet seen them. "A family of, we know not which of the higher mammals, perhaps, the great tree ape, which then

lived in the warm regions of central France, may have produced a few 'sports,' widely differing physically and mentally from the parents, and these 'sports' were the ancestors of man." Here we have a theory submitted to biologists, which is not supposed to be Darwinism or apeism, and yet it bears a strong family resemblance to both. To my vision, it appears inconsistent with some of what has gone before. Its special mission appears to be, to get rid of the "missing link." But he cannot be gotten rid of so easily "This is a theory" Brinton says "which is as good as another." But it is not as good as another, until all the ape characters of man, recent and paleolithic, are explained away. In fact I suspect that the "sporting" is altogether confined to the theory! for paleontology does not give any ground for supposing that sports have any part in the general advance which we call evolution. The process has been by the gradual accumulation of increment after increment. Besides, the "tree ape" turns out to have been a baboon!

E. D. COPE.

SCIENTIFIC NEWS.

The Danish government has decided upon a deep-sea exploration of the waters of Greenland and Iceland. The work will be carried on during 1895 and 1896. A botanist will accompany the expedition.

The American Museum of Natural History has organized an expedition, under the direction of Professor Rudolph Weber, to make collections and a scientific exploration of the Island of Sumatra.

An expedition has been organized in Australia for a scientific exploration of the mountains of Macdonnell near the centre of the continent. The party will be equipped and directed by Mr. W. Astin Horn, a wealthy colonist. The scientific corps is strong and numbers among its members Mr. Winnecke, geographer; Mr. E. C. Strisling, naturalist; Professors R. Tate and Baldwin Spencer, paleontologists; Mr. J. A. Watt, mineralogist.

The American Association for the Advancement of Science has again subscribed $100 for a table at the Marine Biological Laboratory at Woods Holl. Last year it did the same, but, we learn, some of those who should have been consulted concerning its disposition were left in absolute ignorance of any award. This year the table has certain conditions attached, which it is hoped will settle the question of responsibility. These conditions are:

1. That the table shall be known as the American Association for the Advancement of Science table.
2. That the table shall be awarded by a committee of five, consisting of the vice-president and secretary-elect of each of the two sections (F and G), and the director of the Marine Biological Laboratory (at present, Dr. C. O. Whitman).
3. That any member or fellow of the Association may apply for the table (an applicant for membership to the Association will be considered as a member and is therefore eligible).
4. Applications for the table are to be made to the permanent secretary of the Association (F. W. Putnam, Cambridge, Mass.), who will forward them to the chairman of the committee of award, the chairman being the senior vice-president of sections F and G, seniority being determined by continuous membership.

5. Holders of the Association's table will be expected to give due credit in published results of investigations carried on at the Association's table.

The death of the venerable D. C. Danielssen of Bergen, Norway, on July 13th, removes one of the ablest of the Scandanavian systematists. Most of his zoological work was done on the marine Invertebrates and was of an exceedingly careful character. He was besides a physician in regular practice, was the chief of the Leprosy Hospital at Bergen, and since 1864 has been the president of the Bergen Museum. He was born in 1815.

Gustave Honoré Cotteau, the well known paleontologist is dead, aged seventy-six. His principal work was done in the Echinodermata, of which subject he was the leading student in France.

Two of the American Arctic exploring expeditions have come to grief. The vessel of the Chicago newspaper enterprise under Wellman was crushed in the ice and some of the party returned to the Spitzbergen islands, while the leader with others was picked up and landed at Tromsoe, Norway. The Cook expedition which consisted mostly of scientific men, went in an iron vessel in oppostion to the advice of experienced arctic navigators. In her first contact with the ice a hole thirty feet long was torn in her side. She subsequently ran on a rock near to Sukkertappen and subsequently sank. The passengers were brought to Labrador by a passing vessel, but lost all their property.

The Salt Lake Literary and Scientific Association, a body incorporated for scientific pursuits, with headquarters at Salt Lake City, Utah, has recently endowed a chair of Geology in the University of Utah. The endowment is made in the handsome sum of $60,000, the proceeds of which are to be used in the support of the professorship. The chair has been named the "Deseret Professorship of Geology," and Dr. James E. Talmage has been appointed to the position. The rich collections of the Deseret Museum, belonging to the Salt Lake Literary and Scientific Association, have been placed at the disposal of the growing University of Utah. Such a movement is commendable. Utah is a rich field for the geologist, and any substantial encouragement of the science there is an effort wisely directed.

Dr. Chas. L. Edwards, lately of the University of Texas has been elected Professor of Biology in the University of Cincinnati, Cincinnati, Ohio.

☞As the year 1894 is now drawing to a close we would respectfully ask the many delinquents to send in their subscriptions, that we may close our books for the year with a clean bill.

THE

AMERICAN NATURALIST

VOL. XXVIII. November, 1894. 335

THE MECHANICAL CAUSE OF FOLDS IN THE APERTURE OF THE SHELL OF GASTEROPODA.[1]

BY WM. H. DALL.

The folds which are frequently present on the columella and the lip of the aperture of the shells of Gasteropoda, may, I think, be traced to a mechanical cause. In considering the dynamic relations of the animal to its shell we may obtain satisfaction on this point. In the fusiform rachiglossa an anatomical difference exists to which I believe attention has not hitherto been called. Indeed, unless the principles of dynamic evolution are granted it is a difference which would appear to have little or no significance. These principles, however, afford a key which seems to unlock this and many other mysteries. In the plicate forms of this sort the adductor muscle, which in all gastropods is attached to the columella at a certain distance within the aperture, is attached *deeper within the shell* than in non-plicate forms. The point of attachment may be an entire turn, or even more, behind the aperture, while in short globose few-whorled shells and in the non-plicate forms it is, as a general rule, little more than half a turn within the aperture.

---

[1] Adapted from the Transactions of the Wagner Free Institute of Science, Philadelphia, Vol. III, 1890, p. 58.

Now let us consider the dynamics of the case. We have, reduced to its ultimate terms, a twisted shelly, hollow cone, sub-angulate or even channelled at two extremes corresponding to the canal and the posterior commissure of the body and outer lip. Inside of this we have a thin, loose epithelial cone, the mantle, of which the external surface especially toward the margin, is shell-secreting; lastly, inside of the mantle-cone we have a more or less solid third cone, consisting of the foot and other external parts of the body of the animal, which can be extended beyond the mantle-cone outwardly, as the mantle-cone can be beyond the shell-cone. The body-cone and the mantle-cone are attached at one of the angles of the shell-cone some distance within the opening of the spiral of the latter. The two outer cones constitute a loose, flexible funnel within a rigid, inflexible funnel, while the body-cone forms a solid, elastic stopper inside of all.

What will happen according to mechanical principles (which can be tested by any body with the simplest apparatus) when the mantle-cone is withdrawn into a part of the shell-cone too small for the natural diameter of the contracted mantle-cone? It must wrinkle longitudinally. Where will the wrinkles come? They will come at the angles of the shell-cone first; they will be most numerous toward the aperture, since toward the aperture the mantle-cone enlarges disproportionately to the caliber of the shell, owing to its processes, the natural fold of the canal, etc., etc.; the deepest and strongest wrinkles will be over the pillar, owing to the fact that the attachment of the adductor prevents perfect freedom in wrinkling, and the groove of the canal will mechanically induce the first fold in that vicinity. The most numerous small wrinkles will be near the aperture opposite the pillar, because of the mantle-edge this is the most expanded part, and there will be a tendency to a ridge near the angle of the posterior commissure. Repeated dragging of a shell-secreting surface, thus wrinkled, over a surface fitted to receive such secretion, will result in the elevated shelly ridges which on the pillar we call plications, and on the outer lip liræ, if long, or teeth if short. The commonly existing subsutural internal ridge on

the body of the shell near the posterior commissure will mark the special conditions in that part of the aperture.

When the secreting surface is thus wrinkled or corrugated longitudinally the wrinkles and the concave folds between them will be directed in the sense or direction in which the body moves in emerging from or withdrawing to the whorl. The summits of the convex wrinkles will be appressed more or less forcibly against the shell-wall exterior to them in which they are contained. The semi-fluid, living secretion of which the shell-lining is built up, exuding from the whole surface of the mantle, will be rubbed away from the lines of the summits of the wrinkles and tend to accumulate in lines corresponding to the concave furrows between the wrinkles. This secretion hardens rapidly, and these lines would become somewhat elevated ridges which would by their presence (when once initiated) tend to maintain the furrows and wrinkles in the same place with relation to the thus-initiated liræ, as these elevated lines are called when on the outer lip; or plaits, when situated on the pillar.

The modification referred to generally takes place during resting stages of the animals' growth, since while the animal is rapidly extending its coil the secretions seem to be concentrated along the mantle margin, while the general mantle-surface resumes its secretive function (or the latter becomes active) somewhat later, after the formation of a definite shelly varix, or thickened margin, indicating a resting stage in the animal's career. It is probable also that during rapid growth there is less compression of the tissues than during the resting stages. The external sculpture and some of the modifications of the aperture are connected with the functions of the extreme edge of the mantle; those we are at present considering relate more especially to the function of its general surface by which the layer which lines the whorls, the pillar, plaits and liræ are solely secreted and deposited.

In species with the adductor muscle attached to the pillar near the aperture the wrinkles would be fewer, and their action, if any, confined to the vicinity of the margin of the aperture. The deeper the attachment the greater will be the

compression of the secreting surface and the distance over which it is constantly dragged back and forth, and the consequent length of the ridges of shelly matter deposited. If the inner or mantle-cone had the whole cavity to itself, it is evident that it could and would infold itself in a manner which might not appress its folds against the inner surface of the rigid outer or shell-cone. But there the mass of the solid and elastic foot and external body comes into play, and by its withdrawal inward forces the wrinkled mantle-cone against the shell. The mantle is thus confined between a rigid outer and

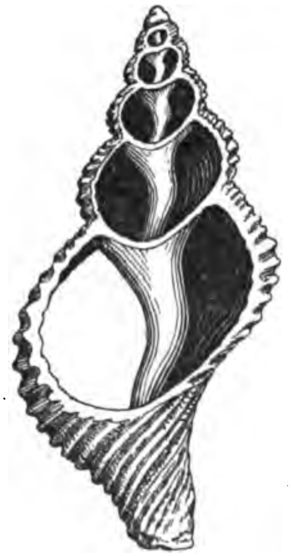


Fig. 1.

Fig 2.

Fig. 3.

Fig. 1. *Fusus parilis* Conr. a gastropod in which the caliber of the spire contracts uniformly within the aperture but which, having a short retractor muscle develops no plications on the axis.

Fig. 2. *Mitra lineolata* Heilprin, a gastropod otherwise similar, but in which the retractor is long and deep seated and in which the axis becomes plicated.

Fig. 3. *Siphocypræa problematica* Heilprin, a gastropod in which the aperture is contracted and the cavity within ample so that plications are developed on the sides of the aperture but not on the axis within.

an elastic inner surface, with the result that it cannot recoil from the former and that a certain uniformity of size and direction is imposed upon the wrinkles, except where the recess of the canal allows them to become more emphatic, or to a less degree, the posterior angle permits a slight expansion. The mechanical principles involved may be readily illustrated by the experiment of pulling a handkerchief through the neck of a bottle, or funnel, followed by a cork in the center. Of course, the more nearly the apparatus conforms to the form and twist of a spiral shell the more nearly the results will approximate to those of nature. It is difficult, however, to find any artificial tissue which will correspond in elasticity, or capacity for partial self-contraction, to the living tissues concerned in nature. Hence an exact conformity is not to be expected though the mechanical principles may be reasonably well illustrated.

A comparison of specimens will show that the results exhibited agree with marvellous precision with the results called for by the preceeding hypothesis, based on the dynamical status of the bodies concerned, their motions and secretions. The agreement is so complete as to amount to a demonstration, though in certain cases there may be complications which need additional explanation.

A point which may be noted in regard to the Volutidæ, to which my attention was called by Mr. Pilsbry, is that in this group the mantle is greatly extended and there would be more of it to be wrinkled than in such forms as Buccinum, etc. It may be added that the forms in which we note the beginning of plaits for this family, many of them, such as Liopeplum and Volutomorpha, had the mantle so extended as to deposit a coat of enamel over the whole shell, as in the modern Cypræa, so that here we have an additional reason why plication should be emphasized in this group.

Of course, as before noted, the mechanical principles are the same in any group of gastropods, but among those in which the wrinkling is confined to the region of the aperture or those shells which are lirate or dentate as opposed to plicate, several other principles come into play which may be briefly referred

to in passing. In the first place, those species which have a very extended mantle, with hardly an exception have a lirate aperture (*Oliva, Olivella, Cypræa, Trivia*, etc.). With species in which there is a widely extended mantle and yet no lirations, it will usually be found that the mantle is not entirely withdrawn into the shell in such forms, or is permanently external to the shell (many *Opisthobranchiata, Marseniidæ, Sigaretus, Harpa*, etc.). In a group, like the *Cypræidæ*, where nearly all the species are lirate on both lips, there are a few which want these liræ, and these are species which have a wider aperture in the adult than most of the genus, and in which we should expect the wrinkles to be less emphatic.

SOME BIRDS OF PARADISE FROM NEW GUINEA.

By Geo. S. Mead.

Of that class of the feathered creation to which the term Birds of Paradise has been applied, and which they certainly most appropriately bear, New Guinea with its adjacent islands is the home, or at least the greater number of the dozen or more species of this unrivalled family belong to these regions. Mr. Wallace, a recognized authority on these birds, as well as on the Malay Archipelago, seems to limit their range to the northern side of the mainland. Other travellers, however, have found them on the southern side, as well as in other parts of New Guinea. The Italian naturalist, D'Albertis, for example, encountered several species, notably *Paradisea raggiana*, along the Fly River—a large stream flowing southeast from the mountains of the interior and emptying into the Gulf of Papua, to the right of Torres Straits.[1]

Yet the northern side, as Mr. Wallace points out, certainly presents as safe a retreat as could be found for these lovely and much prized treasures of the feathered world. Impenetrable swamps, the rugged coast, impassable mountain ranges, fierce tribes of natives, illimitable forests—all these and other barriers are so many means of protection which it is to be hoped will long preserve a wild life that possesses the fatal gift of beauty, against utter extermination.

There is nothing perhaps but physical difficulties or the subsidence of a fashion that can save birds of paradise from the destruction which a barbarous propensity, and the careless

---

[1] "On the south coast of N. G. the vegetation is generally of the most luxuriant character, even for the tropics. One vast dark jungle spreads over its muddy shores, abounding in immense forest trees, whose trunks are hidden by groves of sago palms, and myriads of other heat and moisture-loving plants. Unlike the eastern and southern coasts of N. G., the northwestern part is described as being generally covered with timber, but having no underwood or dense jungle, so that it is very easy travelling under the shade of the lofty trees. The country is said to abound with small fresh-water streams, and patches of good grass." Polynesia, p. 175.

cruelty of women seem to make inevitable. Nature herself, therefore, must shield her own from the complacent notion that everything living is subservient to the whim or caprice of civilization or to the savage who ignorantly ministers to it.

These favored regions, besides those of the Aru Islands, where birds of paradise also abound, are rich in vegetation beyond even the usual fecundity of the tropics. Almost as unique, varied and lovely, are other forms of animal life—butterflies, dragon-flies, lizards, insects great and small, and countless tribes of the feathered race.

In the eyes of lovers of the gorgeous, among birds the king bird of paradise, *Cicinnurus regius*, is without a rival. It is indeed of surpassing loveliness, if, as some one says, an adjective so distinctive can properly be applied to any species when all are so lovely. The bird itself is of small size, nor does the plumage stand forth to that extent it reaches in other species, but within this compass the most perfect, soft and dazzling effects of delicate tints are displayed. While the plumage of all the birds of paradise is singularly beautiful, still more beautiful and magical is the play of shifting lights. The least movement on the part of the bird, the slightest displacement of a feather, the turning of a leaf or the letting in of a sunbeam, produces a wondrous and entrancing change. After death the colors pale, in many instances almost immediately, and of course the evanescent hues lose their startling brilliancy. Over the prevailing tint of red on the king bird, "a gloss as of spun glass wavers." The head is of deep orange, the throat cinnabar, the breast snow-white; between the breast and throat is a dividing belt of rich green. Like silk with its sheen and softness is the white breast; white also is seen over each eye. On either side of the lead-colored legs, at times hidden under the wings, tufted, white-tipped feathers, puffed out like the down on the soft powder-brushes ladies use, are to be noted, for they form a curious adjunct to the dress of the male bird. From the tail-feathers a pair of wire-feathers, five or six inches long, project; these are separated at their ends by an equal distance, and are webbed outwardly so as to form two circlets about the size of a coat-button. Capt. Moresby, in his inter-

esting book, "Discoveries in New Guinea," gives so admirable a description of the king-bird of paradise as to deserve quotation here:

"This bird," he says, "is as large as a small thrush, the back glossy crimson, the head feathers being soft, and deep in tone like velvet, the throat crimson, and separated from the pure white breast by the wide band of green. It has the long wire tail of all birds of paradise, terminating, however, in two circular feathers, about the size of a sixpenny piece, of a burnished green. But its peerless ornaments are two small feather fans of intense emerald color, set in the upper joint of the wing, and capable of being spread or folded at pleasure."

Not unlike the best known of all the birds of paradise, *P. apoda*, is the red-bird, *Paradisea sanguinea*. It cannot, however, be considered as the peer in beauty, its resemblance consisting chiefly in the fall of long plumes from the back, giving that appearance, so characteristic and so attractive, as of a cataract of feathers falling in a maze of wavy lines and spray. Where these soft plumes are golden in *Apoda* the red-bird has a deep crimson. Yellow prevails on the head and neck, extending a short distance on the back. A yellow band passes across the breast, flanked by green and brown. All these tints blend into each other, the line of division never being closely marked excepting on the throat. A corrugated arrangement of short velvety feathers gives a singular appearance to the head; this and the long filaments reaching beyond the loose wing plumage serve in making it one of the most striking ornaments of the bird creation.

The size of *Sanguinea* or *Rubra* is about that of a robin, perhaps a little larger, and its favorite resort the recesses of Waigiou Islands.

Paradisea apoda, the great paradise bird, has become a familiar object of admiration in museums of natural history and collections. In no other bird is the coloring so rich and the blending of browns, purple, green and orange so alluringly beautiful. Add to this the long, curving fall of plumes behind, and one of the most entrancing spectacles animate nature has to show is vouchsafed.

This is the species early brought to Europe by travellers, and even made an object of commerce. No wonder that, deprived of its sturdy, somewhat ugly legs and feet, people fabled the lovely creature to be not of earth but aerial, never settling on gross, material things, nor living on terrestrial food, but passing its halcyon existence above mundane growths, or like matchless Belinda's lock, wafted to the skies:

> "A sudden star, it shot through liquid air,
> And drew behind a radiant trail of hair."

Which last line, it has always seemed to me, fairly well describes the appearance of a shafted bird of paradise while in flight.

In his travels along the Fly River, N. G., in 1872–5, D'Albertis found (what he considered new to science) *Paradisea raggiana*, so named by Mr. Sclater, after Marquis Raggi, of Genoa. This beautiful bird of paradise the Italian explorer described by its differences from *P. apoda* and *P. minor* rather than by any special marks of its own. It is less in size than the great-bird, but in luxuriance of plumage almost its equal. In opulence of colors, too, it vies with the loveliest. A golden belt widening above divides the green throat from the ruby breast; a splash of the same color appears on the wings, while the back is untinged. Red prevails on the side wings running along the floating plumes. It is very probable that *P. apoda* and *P. raggiana* interbreed; possibly other varieties. D'Albertis notes several evident instances of hybrids, and names the characteristic markings of those specified—the yellowish tinge at the back of the throat, the small wing feathers banded with gold, etc. The velvety softness of the feathers is as observable in *Raggiana* as in all birds of paradise, while the exquisite intermingling or suffusion of vivid colors, although at the same time these are quite distinct, is just as inimitable. Long, curving wire-shafts adorn this species also.

Of less flaming colors than the last mentioned species, although the transition of hues is even still more wonderful, and lacking the flowing train of plumes and caudal appendages of other members of its kind, the *Lophorhina superba* or

atra hardly falls behind its congeners in beauty and attractiveness. Instead of the radiant splendor of the *Apoda* or *Raggiana*, the colors of *Superba* are darker but marvellously rich, —purple, violet, green, bronze, blue—ever varying and shifting in changing lights, the whole shot over with satin sheen, while silken gleams run fitfully along the compact feathers which, nevertheless, never lose their velvety softness. While to compensate for waving plumes, we have a gorgeous green bifurcated shield for the breast and two pseudo wings or wing coverings raised or depressed at will. The head glistens as with scales of dark green or blue, according to the reflections. It is not without the singular crests or protuberances which distinguish certain birds of this family, and it is not unlikely that the feathers are at times also erected when the bird is excited or pleased.

The unique adornment, however, of *Superba*, not omitting the curious extensions of metallic green athwart the breast, is the half-united pair of mock wings spreading out when raised, from the shoulders above the head and shadowing the back and sides. The color is black, but blazing with lustre, so that as the light strikes the tips of the feathers they become bronze or blue, or even green, almost iridescent, always resplendent. In size, shape and indescribable coloring, this mantle forms one of the most remarkable combinations of feathers which even a bird of paradise can show, this, too, on a little creature not more than nine inches in entire length.

D'Albertis informs us that the natives of New Guinea call the bird *niedda*, " from the sound of its notes." If this is so, its voice is materially different from the discordant cry of other *Paradisea*.

We hear from the incomparable emerald bird of paradise (*Apoda*), for instance, only a hoarse " wok, wok," or a succession of cawing, unmusical sounds.

In the Golden bird of paradise, *Paradisea sexetacea* or *Parotia sefilata*, we find another example of dark, rich clothing in contradistinction to the gay apparel of other species of the race. The somewhat misleading appellation, golden, is derived from the flashing colors of the gorget or escutcheon

below the throat. The rest of the bird is invested in more neutral tones—black, purple, bronze and green—lighting up into metallic brightness or deepening into dark, funereal velvet with every movement.

As the superb-bird is glorious with great shoulder-crests waving like a duplicated fan, and a two-fold breast shield, so the Golden has its own peculiar mark of uniqueness in the six long threadlike shafts projecting, three on either side, from the head, and terminating in an oval web. These wire feathers are movable and can be thrust at pleasure straight out or thrown back upon the body. The head is still further ornamented with the usual erectile feathers brushed back, as it were, from the beak; some gray in coloring or white shine like jewels or precious stones. On the sides, soft, massive pectoral plumes, jet black, pass beyond and over the wings, covering them when lowered and almost concealing the rounded tail as well.

EXPLANATION OF PLATES.

PLATE XXIX. From Brehm's Thierreich.

Fig. 1. *Paradisea apoda.*
Fig. 2. *Parotia sefilata.*
Fig. 3. *Cicinnurus regius.*

PLATE XXX. From Brehm's Thierreich.

Seleucides alba.

PLATE XXXI.

Paradisea raggiana Scl. from the Natural History of New Guinea.

THE PSYCHOLOGY OF HYPNOTISM.

BY JAS. WEIR, JR., M. D.

The various phenomena accompanying animal magnetism, so-called, have been observed and commented on by man since a very early era in his history. Our savage ancestors, whose psychical development had just begun, considered these manifestations to be a direct evidence of the supernatural, and those individuals who, either actively or passively, gave evidences of this, to them, occult power, to be directly influenced by supernatural agencies. This manner of regarding these phenomena has, in a measure, descended to us, and the vast majority of civilized beings of to-day look with a certain awe on the person who is laboring under hypnotic influence. The sceptical minority, however, generally regard hypnotism as a baseless fraud and imposture. Both classes of individuals are in error; the first, because there is nothing supernatural in the phenomena of so-called animal magnetism; the second because these phenomena really do exist and are the result of perfectly natural causes. The term, animal magnetism, owes its origin to a tradition which came into existence about the middle of the sixteenth century. At that time, man conceived the idea that he could influence his fellows in a manner analogous to that of a magnet, attracting some, and repelling others. The first written evidence of this belief occurs in the works of Paracelsus. He maintained that "the human body was endowed with a double magnetism, that one portion attracted to itself the planets, and was nourished by them, whence came wisdom, thought and the senses; that the other portion attracted to itself the elements and disintegrated them, whence came flesh and blood; that the attractive and hidden virtue of man resembles that of amber and the magnet; that by this virtue, the magnetic virtue of healthy persons attracts the enfeebled magnetism of those who are sick." The latter part of this doctrine is believed by many people at the present

time; witness the widespread belief that an enfeebled person should not occupy the same bed with a strong, lusty individual, lest the enfeebled vitality of the one should be overcome and absorbed by the stronger vitality of the other. Many scientists of the sixteenth and seventeenth centuries, notably Glocenius, Fludd, Kircher, Burgrave, and Maxwell accepted the doctrines of Paracelsus, and declared that all natural phenomena could be explained through magnetism. These learned gentlemen thought that by magnetizing talismans and hanging them about the persons of the sick, that the vital spirit could be infused thence into the bodies of invalids, thus effecting cures.

Anthony Mesmer, who was born in Germany in 1734, discarded the talismans and magical boxes of his predecessors and applied this, so-called, universal principle directly to the bodies of the sick through the agency of passes and contact. In the beginning of his career, however, Mesmer used the magnetic steel tractors of the Jesuit, Father Hell. He soon abandoned them and confined himself to manual manipulations and passes, asserting that animal magnetism was entirely distinct from the influence exerted by the magnet.

In 1779 Mesmer left Vienna and came to Paris, where he at once began to give lectures on his theory of the magnetic fluid. In these lectures he declared that "he had discovered a principle capable of curing all diseases." Says Binet and Feré: "He summed up his theory in twenty-seven propositions, or rather assertions, most of which only reproduce the cloudy conceptions of magnetic medicine." These propositions while they are full of the mysticisms, the errors, and the superstitutions naturally belonging to the period at which they were formulated, yet contain the germs of scientific truths. As I wish to establish, later on in this paper, the fact that certain individuals are more susceptible to hypnotic influence than are others, I will here introduce evidence obtained from the writings of one who witnessed Mesmer's *seances*. Says Bailly: . . . "They are so submissive to the magnetizer that even when they appear to be in a stupor, his voice, a glance, or sign will rouse them from it. It is impossible not to admit,

from all these results, that some great force acts upon and masters the patients, and that this force appears to reside in the magnetizer. It has been observed that *many women* and *few men* are subject to such crises." These crises were characterized by "*convulsions, cries, shouts, and groans.*" The same writer says elsewhere: "It has been likewise observed that they (crises) are only established after the lapse of two or three hours, and that when one is established others soon and *successively* begin." (Certain words and expressions are here and elsewhere italicized for future reference). Mesmer's treatment became exceedingly popular. He, consequently, incurred the jealousy and hatred of the Academy of Science and the Academy of Médicine, these academies emphatically declaring that there was nothing in his method and that his theory was arrant nonsense. Where upon Mesmer left France, notwithstanding the fact that the government offered him a life-pension of 20,000 francs on the sole condition of his remaining and continuing his method of practice. He returned, however, at the solicitation of his admirers who offered him a purse of 10,000 louis for a series of lectures on magnetism. These lectures were published and set the kingdom into a ferment, many declaring that Mesmer was a charlatan and a fraud, while as many more declared that he was a great discoverer and a benefactor of the human race. In 1784 the government ordered an investigation and appointed a commission to inquire into magnetism. Their report is exceeding interesting, in as much as it shows how very near, indeed, these men of wisdom were, in grasping the salient features of hypnotism. Benjamin Franklin was a member of this commission, his name being signed first of all. A translation of report reads as follows: "The commissioners have ascertained that the animal magnetic fluid is not perceptible by any of the senses; that it has no action, either on themselves or the patients subjected to it. They are convinced that pressure and contact effect changes which are rarely favorable to the animal system, and which injuriously affect the imagination. Finally, they have demonstrated, by decisive experiments, that imagination apart from magnetism produces convulsions, and that

magnetism without imagination produces nothing. They have come to the unanimous conclusion with respect to the existence and utility of magnetism, that there is nothing to prove the existence of the animal magnetic fluid; that this fluid, since it is non-extistent, has no beneficial effect; that the *violent effects* observed in patients under public treatment are due to contact, to the excitement of the imagination, and to *mechanical imitation* which involuntarily impels us to repeat that which strikes our senses. At the same time, they are compelled add, since it is an important observation, that the contact and repeated excitement of the imagination which produce the crises may become hurtful; that the spectacle of these crises is likewise dangerous, *on account of the imitation faculty* which is a law of Nature; and consequently that all treatment in public in which magnetism is employed must in the end be productive of evil results.

(Signed) B. FRANKLIN, MAJAULT.
BAILLY, LEROY, D'ARCET.
DEBORY, GUILLOTIN.
LAVOISIER.

Shortly after this report was presented, the Royal Society of Medicine filed their report in which they came to the same conclusions, one member, however, Laurent de Jussieu, dissenting. De Jussieu filed a separate report in which he foreshadowed several points now universally acknowledged to be established truths. He declared that the experiments demonstrated the fact that man was capable of producing a sensible impression on his fellows through the agency of friction or, contact. Charcot has shown that "the efficacy of contact and friction is proved by the existence in certain subjects of hypnogenic zones, of which the slightest stimulation produces somnambulism; that the irritation of hysteriogenic zones produces convulsions, and that these zones are generally seated in the hypochondriac, or in the ovarian regions, on which Mesmer preferred to exercise his manipulations." M. de Puységur of Buzancy, near Soissons gave, in 1784, the first account of hypnotism produced by manipulation, and the sequent phenomena of healing by suggestion. He discovered

PLATE XXIX.

1. *Paradisea apoda.* 2. *Parotia sefilata.* 3. *Cicinnurus regius.* From Brehm's Thierleben

that a patient, whom he was treating for inflammation of the lungs, was thrown into a condition resembling sleep, yet, who retained conciousness, spoke aloud, and attended to his every day affairs. De Puységur discovered that, by suggestion, he could change the current of this patient's thoughts and make him do his bidding, at one moment, weeping as if it in great sorrow, the next, laughing as if convulsed with joy. "In his *waking state* he was *simple* and *foolish*, but during the *crisis* his intelligence was *remarkable*." From 1784 to 1882 the science of hypnotism and the treatment by suggestion was undergoing a slow evolution which finally culminated in the work of M. Charcot, who at last took this beneficial therapeutic agent from the hands of charlatans and quacks, and placed it where it belongs—among the remedial agents of reputable, scientific physicians. I have shown in this brief *resumé* of the history of hypnotism that certain classes of individuals were more susceptible to this influence than others, and that gender was a great and favorable factor. The words previously italicized show that women more frequently than men were influenced by hypnotic suggestion, and that these favorable subjects always gave evidences of hysteria or kindred neurotic lesions. The observations of Charcot and his pupils substantiate the experiences of the older scientists in this respect, and my own experience tallies with that of Charcot. I, therefore, deem it safe to advance the proposition, that the individuals who yield to the influence of hypnotism are always those who are neuropathic; Prof. Charcot wrote me, a short while before his death, that "he had come to the conclusion that all hypnotic subjects were the victims of neurotic lesion in some form or other." When we come to study the psychological phenomena accompanying hypnotism, we at once discover that this is a perfectly natural and absolutely truthful conclusion.

Man possesses two kinds of conciousness—an active, vigilant, co-ordinating conciousness, and a passive, pseudo-dormant, and, to a certain extent, incoherent and non-co-ordinating conciousness. We can readily prove the truth of this by observing certain phenomena which are to be noticed daily among ourselves. A man falls into a "brown study," and, if

gently approached without being startled, he may be asked questions which he will answer intelligently without any concious act on his part. His subconciousness, for the time being, holds him beneath its sway. Yet his active conciousness is not so much obtunded but that he can answer questions intelligently. Again, if a musician seated at a piano and improvising, be approached and gently questioned, he will answer the questions intelligently without ever ceasing his improvisation. His subconciousness is elaborating the sweetest harmonies, yet his active conciousness is not so far away but that it can give utterance to co-ordinating thought action.

Again, when the active conciousness is stilled in slumber, subconciousness sometimes remains awake and makes itself evident in dreams. The lack of rational thought—co-ordination in subconciousness is shown by the more or less extravagance and incoherence of dreams. Everything, no matter how unnatural and extravagant, occurring to the dreamer, is accepted by him as being natural and consistent. When, however, his active conciousness is aroused, he at once recognizes the incocoherence of his dreams. I hold, emphatically, that all dreams, when closely studied, will show extravagance and incoherence. A dream may seem, at first glance, to be entirely coherent, but, if the remembrance of the dream be perfect and it be closely studied, numerous incoherences will always be discovered.

We know how easy it is for us to lose ourselves in abstraction. We will sit for several moments seemingly in profound thought, yet when suddenly aroused and asked what engaged our thoughts, we are unable to tell. We have been in a subconcious state, probably revelling in the wildest vagaries. Fortunately for us, degeneration has left no weakened spot in our active conciousness on which to engraft the erotic imaginings of our non-coordinating subconciousness, consequently our moments of subconciousness are blanks. The favorable hypnotic subject is easily thrown into the subconcious state. The sudden entrance of a bright light into a darkened room ; a loud noise ; a sudden stillness after prolonged noise ; the crackling of a lighted match ; a breath of cold or warm air is all that necessary, sometimes, to bring about hypnosis. I

regard hypnosis as a state analogous to that of the "brown study" in which active conciousness is obtunded or asleep. It is, however, an intensified and aggravated form of mental abstraction, in which active conciousness is, more or less, profoundly affected. Why is it, that in the case of the favorable subject of hypnotism, the active conciousness can be so easily overcome? Simple because it is weakened by neurotic degeneration. That portion of the psychic system in which dwells active conciousness is always the first to degenerate and lose its tonicity. This is shown by the thousands of erotic mental habitudes and perversions that are to be noticed in neuropathic and psychopathic individuals. Active conciousness—the balance-wheel of the psychic system, becomes disordered and at once a flood of erotic fancies make themselves evident. It stands to reason that, in an individual, who shows by his actions and his thoughts that he is the victim of nervous degeneration, his active conciousness would be easily obtunded and put to sleep. This is, emphatically, the case, a fact that is clearly demonstrated by the favorable hynotic subject, who is always neuropathic. We know that subconciousness is capable of receiving an impression and of acting entirely independent of active conciousness—witness the phenomena of somnambulism.

When this fact is admitted the phenomena of hypnotic suggestion are readily accounted for and understood. We have seen that many subjects fall into the hypnotic state when excited by the most trivial extraneous influences such as the scratching of a match; a sudden noise; or a sudden stillness coming after long and continuous noise. Again, hypnosis can be produced by the favorable subject, sometimes, without the aid of extraneous influences. A patient of mine, an hysterical woman, would seat herself in a chair, "look cross-eyed," and, in a very few moments, become hypnotized. On one occasion, in order to test her condition, I commanded her to repeat the following lines, in lieu of the usual blessing, the next morning at breakfast: "*Juro tibi sanctæ per mystica sacra Dianæ me tibi venturam comitem sponsamque futuram.*" I wrote these lines on a slip of paper and gave it to her husband, a good Latin scholar, who declared that she repeated them word for word,

giving the correct pronounciation, adding, however, the word "amen." This lady had never studied Latin and was not familiar with the quotation. Another patient, a young girl, who was psychopathic and neurothenic, could hypnotize herself by gazing at the brass ring of a window curtain. Both she and I discovered this fact accidently, I, having discovered her, on one occasion, in a hypnotized state, intently gazing at the brass ring just mentioned. By a systematic course of fasting and mental abstraction, thus weaking active conciousness, the *tchogis* and *fakeers* of India are enabled to throw themselves into a hypnotic condition at will. I have seen so-called spirit-mediums and clairvoyantes who could bring about hypnosis a dozen times daily if necessary. Surely no one will assert that these subjects are influenced by magnetism emanating from themselves or from outside objects. One might just as well accept the doctrines of Paracelsus and his disciples of the sixteenth and seventeenth centuries. We have seen that the usual avenues to the hypnotic state lie through the senses of sight and hearing, yet the sense of touch affords another avenue. On the bodies of favorable subjects there are certain areas called hypnogenic zones. When these zones are rubbed or tickled the subject immediately passes into the hypnotic state. In conclusion let me state, that I am confident that hypnosis can be produced in the favorable subject, through many different avenues or agencies, and that every one of these agencies will be absolutely devoid of magnetism or any occult force.

RULES OF NOMENCLATURE ADOPTED BY THE INTERNATIONAL ZOOLOGICAL CONGRESS, HELD IN MOSCOW, RUSSIA, 1892.

Part II.

Translated by Moritz Fischer.[1]

I. Nomenclature of Hybrids.

1. (*a*) In the naming of hybrids the name of the male should preceed that of the female, and be united with the latter by the sign of multiplication. The use of the astronomical signs to indicate sex can be dispensed with. Of the two examples following, either can be used, as *Capra hircus* ♂ × *Ovis aries* ♀, or *Capra hircus* × *Ovis aries.*

(*b*) Another method can be employed for this purpose. The two names can be represented as is a fraction, the name of the male forming the numerator, and that of the female the denominator, as $\frac{\text{Capra hircus}}{\text{Ovis aries.}}$. This second method possesses the advantage that the name of the observer can be indicated whenever such indication is desirable, as $\frac{\text{Bernicla canadensis}}{\text{Anser cygnoides}}$ Rabé.

(*c*) The second method should be employed where either one of the parents is a hybrid, as $\frac{\text{Tetrao tetrix} + \text{Tetrao urogallus}}{\text{Gallus gallinaceus}}$.

(*d*) In case the parents of a hybrid are unknown, it provisionally takes a simple specific name like a true species, but the generic name is preceded by the multiplication sign, as ×*Salix erdingeri* Kerner.

II. Generic Names.

2. Every foreign word employed, either as a generic or specific name, should retain the meaning it has in the language from which it is taken, if in this language it denotes an organized being, as *Batrachus bdetta.*

III. Specific Names.

3. The geographical names of uncivilized countries, and of such peoples as do not use the Latin alphabet, should be tran-

---

[1] The first part of these rules was published in the American Naturalist for May, 1892.

From the *Revue Scientifique*, No. 15, tome 50.

scribed according to the rules adopted by the *Geographical Society of Paris.*

4. Both the preceeding article and article 21 of the rules adopted by the Zoological Congress of Paris, in 1889, are applicable to names of persons, as *Boydanovi, Metcknikovi.*

5. The virginal spelling and all diacritic signs must be preserved in the Roumanian and certain other Slavonic languages (Polish, Croatien, Bohemian), and likewise in those which use the Latin alphabet, as *Tænia Medići, Congeria Cžjzžki.*

6. Specific names may be formed from feminine patronymics or from common nouns. In such cases the genitive takes the ending *oe* or *orum* to the full name of the person to whom one dedicates, as *Merianoe, Pfeifferoe.*

IV. SPELLING OF GENERIC AND SPECIFIC NAMES.

7. (*a*) Patronymics or surnames used for specific names must always be spelled with a capital letter, as *Rhizostoma Cuvieri, Francolinus Lucani, Laophonte Mohammed.*

(*b*) A capital letter can be used with certain geographical names, as *Antillarum, Galliae.*

(*c*) In all other cases, the specific name is spelled with a small letter, as *Oestrus bovis, Corvus corax, Inula helenium.*

8. If the name of the subgenus is cited, it should be placed in parenthesis between the generic and specific names, as *Hirudo* (*Haemopis*) *sanguisuga.*

9. If the name of a subspecies or variety is cited, it follows the specific name without any inter-punctuation. The name of the author of this subspecies or variety can be cited likewise without inter-punctuation, as *Rana esculenta marmorata* Hallowell.

10. If a species has been placed in a genus other than the one to which it was assigned by its author, the name of this author is retained in notation, but placed in parenthesis, as *Pontobdella muricata* (Linné).

V. SUBDIVISION AND CONSOLIDATION OF GENERA AND SPECIES.

11. If a species is subdivided, the limited species to which is applied the name of the original species receives a notation

indicating both the name of the author who established the same and the name of the author who subdivided the species as *Taenia pectinata* Goeze partim Riehm.

According to article 8, the name of the first author is put in parenthesis if the species has been placed in a different genus, as *Moinezia pectinata* (Goetze partim) Riehm.

VI. Family Names.

12. A family name must be discarded and replaced by another if the generic name from which it was formed is a synonym, and is itself discarded.

VII. Law of Priority.

13. Zoological nomenclature dates from the issue of the sixth edition of *Systema naturae*, published in 1758. This is the standard work to which that zoologist must refer who wishes to investigate and employ the oldest generic and specific names, provided they conform to the fundamental rules of nomenclature.

14. The law of priority is applicable to family names or to those of higher groups, as well as to the names of genera and species, provided groups are concerned which have a similar extension.

15. A species which has been wrongly identified, must take its correct name, according to article 35 of the rules adopted by the Zoological Congress of 1889.

16. The law of priority must obtain, and consequently the oldest name must be retained.

(*a*) When some part of a creature has been named before the creature itself was known, as in the case of fossils.

(*b*) When the larva, supposed to be an adult form, has been named before the adult form was known.

Exception should be made for the Cestodes, the Trematodes, the Nematodes, the Acanthocephales, the Acariens and, in fine, for all animals passing through metamorphic and migratory stages. Many of these species are now being revised, and their nomenclature will possibly undergo a complete change.

(*c*) When the two sexes of the same species have been considered as distinct species or as belonging to different genera.

(*d*) When the animal presents a regular succession of unlike generations, which have been considered as belonging to divers species or even genera.

17. It is very desirable that each new description of a genus or species be accompanied by a diagnosis in Latin, or, at least, a diagnosis in one of the four best known European languages, i. e., French, English, German, Italian.

18. In works not published in one of the above-mentioned languages, the explanation of the plates should be translated entire, either into Latin or one of the continental languages.

19. When several names have been proposed simultaneously, and priority for any one cannot be established, there should be adopted—

(*a*) That name which is applied to a well-characterized and typical species, in case of a generic name.

(*b*) That name which is accompanied by either figure, diagnosis or description of an adult form, in case of a specific name.

20. Generic names already employed in the same kingdom cannot be used.

21. The use of those names should be avoided which can only be distinguished by their gender endings or by a simple orthographic change.

22. Specific names already employed in the name genus cannot be used.

23. The generic and specific names which become non-available through the application of the foregoing rules cannot be employed anew, even if they express a new meaning in the same kingdom, if the name is generic; in the same genus if the name is specific.

24. A generic or specific name once published cannot be withdrawn, even by its author, on account of ambiguity.

25. All barbarisms and solecisms must be corrected; hybrid names, however, such as *Geovula*, *Vermipsylla* should be retained.

VIII. ALLIED QUESTIONS.

26. The metric system is the only one employed in zoology. Foot and span, pound and ounce should be banished forever from scientific language.

27. Heights and depths, speed and all other common measures are expressed in metres. Fathoms, knots, nautical miles and like terms should disappear from scientific language.

28. The one-thousandth part of a millemeter (Omm, 001), represented by the Greek letter μ, is the unit of measure adopted in micrography.

29. Temperatures are expressed in degrees of the centigrade thermometer of Celsius.

30. The indication of the enlargement or the reduction of an illustration is indispensable to its correct understanding. This indication is expressed in numbers and not by noting the number of the objective which was employed in producing the illustration.

31. It is proper to indicate whether a linear or a surface enlargement has been employed. These notations can easily be abridged, as : × 50 □, indicating a surface enlargement of fifty times; × 50 — indicating a linear enlargement of fifty times.

PRAIRIE CHICKEN AND WILD PIGEON IN JACKSON COUNTY, MICHIGAN, 1894.

By L. Whitney Watkins.

It has been nearly twenty years since the last prairie chicken, *Tympanuchus americanus*, was seen in this or neighboring localities. Occasionally reports have come to me of their presence still, in the vicinity of Freedom Swamps Washtenaw County, and Portage and Wolf Lakes Jackson County. Careful investigation, however, has found these reports founded, usually, upon the exaggeration of some hunter, possessed of an enthusiastic turn of mind, and entirely lacking in substantial evidence.

In 1893 we have the following notes on this species from neighboring counties: "Extinct at Ann Arbor, Washtenaw County," Dr. J. B. Steere. "Extinct for more than thirty years in Monroe County," Jerome Trombley. Authorities have generally regarded them as a game bird figuring only in the romantic past of this part of Michigan.

On April 22, 1894, Charles V. Hay, a clever sportsman of a town near at hand, brought me the welcome news that on the day previous he had actually flushed sixteen "chickens" in Merrill's cranberry marsh of about thirty acres extent and not a mile from the village of Norvell. As Mr. Hay has hunted these birds on the western plains there could be little doubt of the identity, and sure enough they were easily found, in all their old-time glory, a few days later. Local hunters were much excited as the news spread, and old followers of the "sport with rod and gun" shook their gray heads in silent amazement. They would as soon have expected to again witness the running ascent of the wild turkey among the broad-topped trees of the "Oak Openings," as the plunging rise of the prairie hen from the adjoining meadow. These birds are now nesting and once again the loud "booming" of the cocks

has resounded back and forth among the hills which have not known the old familiar sound for many a year before.

Adolphe B. Covert, the veteran ornithologist and taxidermist of Washtenaw County, tells me that a small band of prairie chickens has continued to live in a tract of marsh land some distance from Ann Arbor, notwithstanding Dr. Steere's notes to the contrary. Thus it is very probable that our immigrants, unless they switched off from some western contigent of Coxey's Army, came from some such isolated locality where yet a few pairs nest, rather than in a long flight from the southwest as many would believe.

On June 13, 1894, late in the afternoon, as I was returning from an interesting day among the late-nesting water birds, a fine male wild pigeon, *Ectopistes migratorius*, was startled from a plowed field, lately sown to buckwheat, and rose in full view not more than thirty feet away, affording identification of which I am positive. He flew a few rods and dropped gracefully into the dense foliage of a maple tree by the roadside. Then as I approached, wondering at the presence of the beautiful bird, now so rare, whose garnished plumage turned the rays of the sun into a thousand bright reflections, and in a land over which, in numbers eclipsing all other species, his ancestry once fairly swarmed, he again took wing and with a rapid, measured tread of his pointed pinions disappeared in an instant over the wooded hills beyond. But the old-time flights of pigeons are forever of the past. It had been nine years since the last few were seen here, and we had begun to think it very probable that they would never again be noted.

On June 16, a pair were seen in the same field and on June 18 three were noted by my brother, two of which he was very certain were young of the year. Perhaps a pair of "$2.00 eggs" were hatched in this very locality.

Of the disappearance of the wild pigeon in Southern Michigan, we have the following notes: "Extinct at Ann Arbor in 1875," Dr. J. B. Steere. "Extinct in Monroe County in 1885," Jerome Trombley. "Last seen at Morrice, Mich., in 1881," Dr. W. C. Brownell.

We thus see that birds long supposed to be of the past may yet linger with us in a few lonely specimens. Oh! that we might reinstate again the proud hosts of the mystic past in the lands they once adorned, and in whose ornithological features they once figured so prominently. To this land a few still cling in loving faithfulness to the traits of an innumerable ancestry.

EDITORIALS.

We have frequently complained in these columns of the exclusive conduct of scientific enterprises by persons not acquainted with the sciences and not engaged in their pursuit. We will not enumerate the blunders committed by such persons under such circumstances, as they have recently come under our observation; but only refer now to a question of taste in which some of these well meaning persons have immortalized themselves in stone. A new building for the use of the collections of the Academy of Natural Sciences of Philadelphia was recently erected, chiefly from money appropriated by the Legislature of Pennsylvania. An entrance doorway was devised, and in order that it should represent the uses of the building, it was adorned with figures and reliefs of animals. Persons possessed of the least spark of originality would have seen the propriety of representing in these figures something appropriate to the country, and if possible the institution. Nothing would have been easier than to have placed at the entrance of the Museum, figures of some of the forms of life discovered by its members. The idea was suggested to the gentlemen in charge of the construction, but to commemorate in so conspicuous a manner the services of the naturalists of the Academy it did not strike them favorably. So it came that the apex of the entrance was surmounted by, not even an African lion, but an official British lion, with his mane brushed into a collar like Punch's dog, such as one sees on Government buildings in Great Britain. On each side is a lioness similar to those seen on buildings all over the world. At the summit of one lateral column is a head of a hound, and on the other side a ram with very unsymmetrical horns, both foreign importations. Of the animals in relief above the door, the only American animal is a crab, *Lupa diacantha*, which is indeed, very appropriate to the building commission, as it generally goes backwards, and pinches its nearest neighbors.

—When the natural sciences are taught in our public schools, there will be fewer absurd and untrue stories published in the newspapers. Thus a recent Philadelphia paper tells of a man in Arizona who had two Helodermas ("Gila monsters"), each three feet in length, which acted as watch-dogs for him, and which killed a would-be assassin who entered his house at night. From New York comes a story of a physi-

cian who fed his guests with cholera bacilli, and thus caused their deaths. This doctor is said to reside in Buenos Ayres, and his name is given. A New York paper publishes a reporter's interview with the Governor of Illinois, in which that worthy is made to say that he is afflicted with locomotor ataxia. According to the Governor, the interview never took place. Here inaccuracy has passed into mendacity, as in the case of the *New York World's* interview with the astronomer Secci, which were shown to have been pure inventions. One of the editors of this journal thought he would investigate the source of stories as to the frequent appearance of an alleged ghost on a moor south of Brooklyn last August. These stories had been published in a conspicuous way in several papers of New York and Brooklyn for several weeks, and it seemed worth while to look into a matter which they published as serious news. Nothing was seen, however, but a few young men, among whom were reporters of the *Brooklyn Eagle*, the *New York Sun*, and the *New York World*. The last-named confessed to having himself filled the rôle of ghost on one night by using newspapers, so that this ghost, like most others, appears to have been of a purely subjective origin on the part of one newspaper at least.

—LIEUTENANT PEARY'S party has returned, leaving him to prosecute his researches with only two companions. The results to geography are not great, as he was compelled to abandon the expedition to the northeast coast of Greenland, owing to extreme severity of the weather. Some of the men who have returned, have been talking in a way which shows that they are not adapted for service on an exploring expedition, and Lieutenant Peary is, apparently, well rid of them. It is hoped that the next season will be more propitious. We express here our regret that the Academy of Natural Sciences of this city has not contiuued to interest itself officially in this important enterprise, as it did in the beginning.

—AN artificial taste or custom has often interfered with healthy natural processes in human affairs. The follies of human fashions are innumerable. We refer now to one of minor importance, and yet one which well illustrates the proposition—that is, the alleged fattening of oysters for the market: The nearer the habitat of an oyster approaches salt water, the better will its flavor be, as, for example, the Blue Points of Long Island Sound, the Chincoteagues of the Maryland Coast, the Norfolks of Virginia and the Baratarias of Louisiana. These oysters all have, in the natural state, a brownish or yellowish tint, which, to the connoisseur, is a sure indication of their superior merits. Here,

however, the perversity of an artificial taste enters. Many people must have them white. Such persons prefer a comparatively fresh water oyster, as the Maurice River Coves of the Delaware and those of the upper Chesapeake. Also, if they are not fat they must be made so. To accomplish these two most undesirable ends, the oysters are supplied with fresh water so gradually as not to kill them immediately. They lose the russet tint of health if they have it, and become swelled up by endosmosis. Their flavor is destroyed and is replaced by one that strongly reminds one of that of the leucomaines produced in the stomach by indigestion. The oysters are thoroughly sickened, and in this state are sold and eaten in large numbers by multitudes who do not know the flavor of that most excellent mollusc, a healthy salt water *Ostrea virginica.*

—THIS year was very wet during the spring in the Eastern States, and this period was followed by one of the severest draughts known in our history, which is now, fortunately, broken. The heat of the summer was nearly or quite equal to that of 1876. Whether these peculiar conditions be the cause or not, the scarcity in the same region of batrachians, reptiles and birds during the past season has been exceptional.

RECENT BOOKS AND PAMPHLETS.

Allen, J. A.—Description of *Didelphis* (*Micoureus*) *canescens* sp. nov., from the Isthmus of Tehuantepec, Mexico.——On Birds from Matto Grosso, Brazil.

——Further Notes on Costa Rican Mammals with Description of a New Species of Oryzomys. Extrs. Bull. Am. Mus. Nat. Hist., Vol. V, 1893. From the author.

Allen, J. A. and Chapman, F. M.—On a Collection of Mammals from the Island of Trinidad, with descriptions of New Species. Extr Bull. Am. Mus. Nat. Hist., Vol. V, 1893. From the author.

Bangs, O.—Description of a New Field-mouse (*Arvicola terrænovæ*) from Codroy. Extr. Proceeds. Biol. Soc., Washington, July, 1894. From the author.

Bell, R.—Pre-Paleozoic Decay of Crystalline Rocks north of Lake Huron. Extr. Bull. Geol. Soc. Am.. Vol. 5, 1894. From the Society.

Boettger, O.—Eine neue Eidechse aus Südwest Africa. No. 5 Abhandl. und Ber. d. Königl. Zool. v. Anthropol. Mus. zu Dresden, 1892, 1893.

——H. A. Pilsbry und die Verwandtschaftsbeziehungen der Helices im Tertiär Eurpas. Separat-Abdruck aus Nachrichtsblatt der Deutschen Malakozool. Gesellschaft, No. 5 u 6, 1894.

——Diagnosen eines Geckos und eines Chamelons aus Süd. Madagaskar. Separat-Abdruck aus dem Zool. Anz., No. 445, 1894.

Boulenger, G. A.—On Remains of an Extinct Gigantic Tortoise from Madagascar (*Testudo grandidieri* Vaillant). Extr. Trans. Zool. Soc. London, 1894. From the author.

Brown, A. E.—Species of North American Bears. Extr. Forest and Stream, Dec., 1893. From the author.

Bulletin No. 101, 1894, North Carolina Agric. Exper. Stat.

Bulletin No. 51, 1894, Massachusetts State Agricultural Experiment Station.

Call, R. E.—On the Geographic and Hypsometric distribution of North American Viviparidae. Extr. Am. Journ. Sci., Vol. XLVIII, 1894. From the author.

Chamberlain, T. C. and Leverett, F.—Further Studies of the Drainage Features of the Upper Ohio Basin. Extr. Am. Jour. Sci., Vol. XLVII, 1894. From the author.

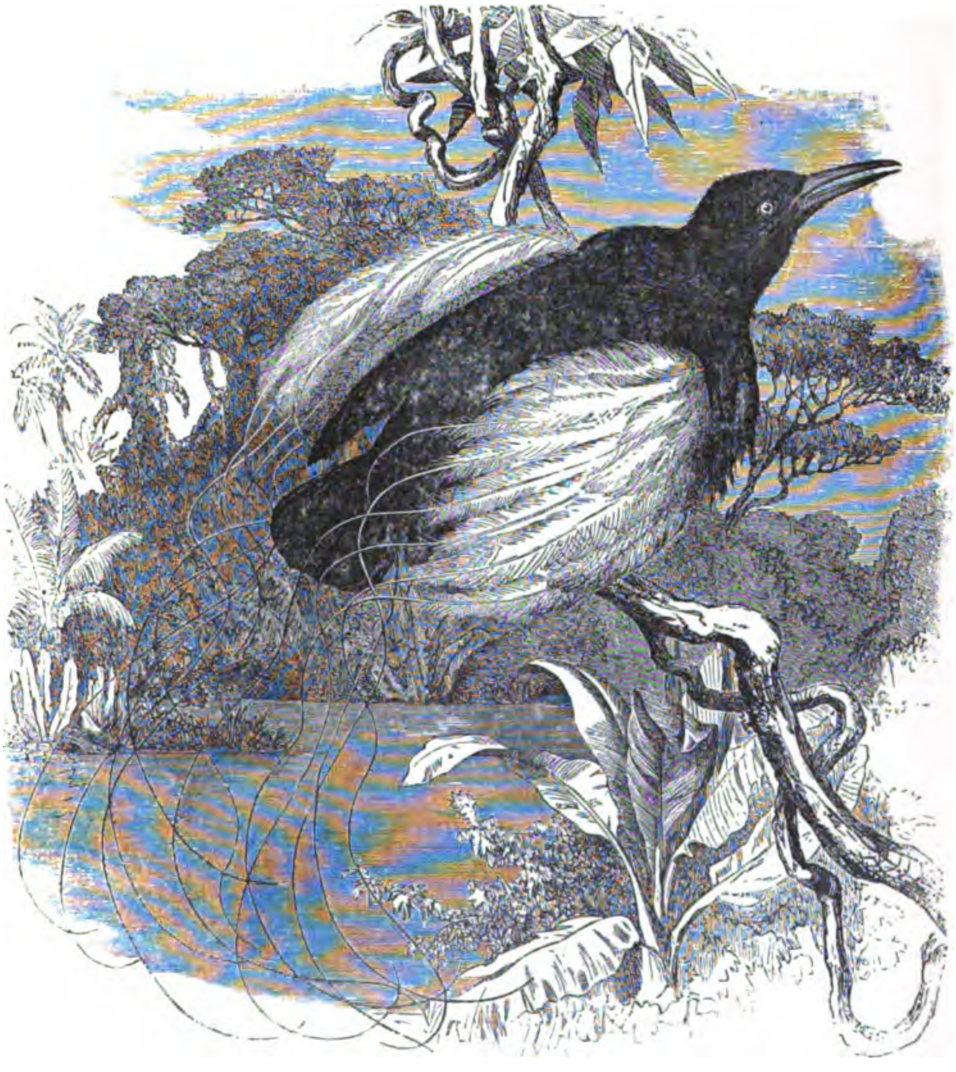
Chapman, F. M.—Description of a New Subspecies of Oryzomys from the Gulf States. Bull. Am. Mus. Nat. Hist., Vol. V, 1893. From the author.

Cope, E. D,—New and Little-known Paleozoic and Mesozoic Fishes.——On Cyphornis, an extinct genus of birds.——Extinct Bovidae, Canidae and Felidae from the Plistocene of the Plains. Extrs. Journ. A. N. S. Phila., Vol. IX.

Credner, H.—Die Stegocephalen und Saurier aus dem Rothliegende des Plauen'schen Grundes bei Dresden. Aus der Zeitschr. d. Deutschen geologisch. Gesell. Bd. XXXIII, XLV, und aus der Naturwissensch. Wochenschrift Bd. V, Berlin, 1890. From the author.

Dawson, J. W.—New species of cretaceous Plants from Vancouver Island. Extr. Trans. Roy. Soc. Canada Sect. IV, 1893. From the author.

PLATE XXX.



Seleucides alba. From Brehm's Thierleben.

Deperet, M.—La Classification et le Parallélism du System Miocène. Extr. du Bull. de la Soc. Geol. de France T. XXI, 1893.——Sur un gisement sidérolithique des Mammifères de l'éocène moyen à Lissien, près Lyon. Extr. Comptes-Rendus de'l'Acad. de Sci. Paris, 1894. From the author.

Dollo, L.—Nouvelle Note sur l'osteologie des Mosasauriens. Extr. Bull. Soc. Belge Geol. Paleon. et. Hydrol., 1894. From the author.

Fleck, Ed.—Vorkommen und Lebensweise der Reptilien und Batrachier. Sonderabdruck aus Ber. Senckenb. naturf. Gesell. in Frankfort A. M., 1894. From the author.

Garman, H.—A Preliminary List of the Vertebrate Animals of Kentucky. Extr. Bull. Essex Inst. Salem, 1894. From the author.

Haeckel, E.—Bericht über die feier des sechzigsten Geburtstages. Jena, 1894.

Hobbs, W. H.—Volcanite, an Anorthoclase-Augite Rock chemically like the Dacites. Extr. Bull. Geol. Soc. Am. Vol. 5, 1893. From the author.

Johns Hopkins Hospital Reports, Vol. IV, Nos. 4–5, 1894. Report in Neurology.

Jorgensen, A.—Hansen's System of Pure Yeast Culture in English Top-Fermentation. Extr. Trans. Inst. Brewing No. 8, Vol. VII, 1874. From the author.

Lamb, D. S.—The Female External Genital Organs; a criticism on current anatomical description. Extr. New York Journ. Gyn. and Obstet., Aug., 1894. From the author.

Locy, W. A.—The Derivation of the Pineal Eye. Extr. Anat. Anz. IX, Bd. Nr. 5 & 6. From the anthor.

Miles, M. Dr.—How Plants and Animals grow. Extr. Pop. Sci., 1893.

Miller, G. S., Jr. and Bangs, O.—A new Rabbit from Western Florida. Extr. Proceeds Biol. Soc. Washington, June, 1894. From the author.

Momlon, M.—Discours prononcé aux Funérailles de P. J. Van Beneden, Membre de la Classe des Sciences. Extr. Bull. Acad. Roy. de Beligique 3d série t. XXVII, 1894. From the author.

Mourlon, M.—Sur la création d'un Bureau International de Bibliographie. Extr. Acad. Roy. de Belgique, 1894. From the author.

Pfeffer, G.—Die inneren Fehler der Weismannschen Keimplasma-Theorie. ——Die Umwandlung der Arten ein Vorgang funktioneller Selbstgestaltung.—— Sonderabzug aus den Verhandl. des Naturwiss. Ver. Hamburg, 1894. From the author.

Powell, J. W.—The Geologic Map of the United States. Extr. Trans Amer. Inst. Mining Engineers, 1893. From the author.

Reports on the Aquarium of the U. S. Fish Commission at the World's Columbian Exposition. Extr. Bull. U. S. Fish Commission for 1893. From Dr. S. A. Forbes.

Report of the Commissioner of Fish and Fisheries on Investigations in the Columbian River Basin in regard to the Salmon Fisheries. Washington, 1894.

Russell, H. L.—Dirt in the Dairy and what it does for Milk. Extr. Wisc. Farmer, 1894. From the author.

Seeley, H. G.—On a Reptilian Tooth with two Roots. Extr. Ann. Mag. Nat. Hist. Vol. XII, 1893. From the author.

SHUFELDT, R. W.—On cases of Complete Fibulae in existing Birds. Extr. The Ibis, July, 1894. From the author.

SMITH, E. A.—The Post-Eocene Formations of the Costal Plain of Alabama. Extr. Am. Journ. Sci., Vol. XLVII, 1894. From the author.

STEARNS, W. A.—Description of *Atherina penikesea* Stearns. No date given. From the author.

TARR, R. S.—Lake Cayuga a Lake Basin. Extr. Bull. Geol. Soc. Am. Vol. 5, 1894. From the Society.

TOWNSEND, C. H. T.—A new Trypetid from Chacaltinanguis, Mexico, with a Note on *Hexachaeta amabilis* L. W. Extr. Loe. Vol. IV, 1893.——Comments on Mr. Van der Wulps recent diagnosis of new species of Mexican Phasiidae, Gymnosomatidae, Ocypteridae and Phaniidae. Extr. Can. Entomol., 1893.——A Cabbage-like Cecidomyiidous Gall on Bigelovia. Extr. Psyche, 1893. From the author.

Twenty-second Annual Report of the Board of Directors of the Zoological Society of Philadelphia.

WADSWORTH, M. E.—A Paper on the Michigan Mining School. Lansing, 1894. From the author.

WARD, L. F.—Fossil Cycadean Trunks of North America, with a Revision of the Genus Cycadeoidea Buckland. Extr. Proc. Biol. Soc. Wash., Vol. IX, 1894. From the author.

WHITE, C. A.—Memoir of Amos Henry Worthen 1813-1888. Washington, 1893. From the author.

WILLISTON, S. W.—A New Dicotyline Mammal from the Kansas Pliocene. Extr. Science, Vol. XXIII, 1894.

WINSLOW, A.—The Art and Development of Topographic Mapping. Extr. Engineering Mag., 1893. From the author.

WRIGHT, G. F.—Continuity of the Glacial Period. Extr. Am. Jour. Sci., Vol. XLVII, 1894. From the author.

RECENT LITERATURE.

Amphioxus and the Ancestry of the Vertebrates.[1]—This important monograph will be welcomed by all students of zoology as as a valuable accession to the literature of the theory of descent. More than this, the volume bears internal evidence throughout of painstaking care in bringing together, in an exceedingly readable form, all the essential details of the structure and metamorphosis of amphioxus as worked out by anatomists and embryologists since the time of Pallas, its discoverer. The interesting history of the changes it undergoes during metamorphosis, especially its singular asymmetry, is clearly described and ingenious explanations of the phenomena are suggested.

Most important, perhaps, are the carefully suggested homologies of the organs of *Amphioxus* with those of the embryos of the vertebrates above it in rank, especially those of the Marsipobranchs and Selachians. Though the comparisons with the organisms next below amphioxus, such as the Ascidians, *Balanoglosus*, *Cephalodiscus*, *Rhabdopleura* and the Echinoderms, will be found no less interesting. In short, the book may be commended to students already somewhat familiar with zoological facts and principles, as an important one to read. They may thus be brought to appreciate to what an extent the theory of descent is indebted to the patient labors of the zoologists of the last forty years for a secure foundation in observed facts, seen in their proper correlations, according to the comparative method.

The figures are good and there is very little that can be adversely criticised in the book. On page 176 it is stated that the ectoderm is not ciliated in any craniate vertebrate. To this statement exception must be taken in regard to the ectoderm of the sides of the body and especially the tail of young tadpoles just hatched. Born in his experiments, in grafting pieces of young tadpoles upon one another, found that the tail, when cut off and lying on its side, had a power of movement, in the cephalad direction, that could be explained only on the supposition that the ectoderm of the sides was more or less extensively covered with cilia. This observation the writer has confirmed in repeating Born's experiments in just hatched tadpoles of *Rana*. The

---

[1] Volume II of the Columbia University Biological Series, by Arthur Willey, B. Sc. 8vo, pp. 316, 135 figures. New York, MacMillan & Co., 1894.

volume, however, brings together everything essential that has ever been made out in regard to *Amphioxus*, so that zoologists will everywhere feel grateful to Mr. Willey for placing in their hands this very useful summary of its life history. The work contains not a little that is new, and some new figures not hitherto published. A very complete bibliography and index completes the volume. One hundred and thirty-three titles are comprised in the list of papers and works consulted in the preparation of the volume. If the other volumes in course of preparation by the professors in biology of Columbia University are up to the high standard of the present one, that institution is to be congratulated upon the enterprise of those who have initiated the project.—R.

Correlation Papers of the U. S. Geol. Survey: Archean and Algonkian.[1]—This memoir, written by Prof. C. R. Van Hise, is the seventh of the Correlation Papers series, and is, perhaps, one of the most important of that valuable set. The pre-Cambrian rocks of the United States and Canada, for convenience, are considered under the heads of seven districts, which are severally discussed in as many chapters. Each chapter is prefaced with abstracts of all the articles pertaining to the subject considered, classified by dates, together with summaries of the conclusions which appear to be established. Chapter VIII summarizes the various successions proposed, suggests one, and discusses the principles of pre-Cambrian stratigraphy. The Archean is the basal complex of America. It has everywhere, if large areas are considered, an essential likeness. It consists mainly of granitic, gneissic and schistic rocks, among which are never found beds of indubitable clastics. When different kinds of rocks are associated, their structural relations are intricate, which, together with the crystalline schistose character of the rocks, the broken and distorted mineral constituents, and involuted foldings are evidences that these rocks have passed through repeated powerful dynamic movements.

In regard to Algonkian stratigraphy, the writer accepts the structural and lithological principles enunciated by Irving, Pumpelly and Dale. It remains to be demonstrated, however, to the satisfaction of most geologists that the formation termed Algonkian, is not a part of the Cambrian.

[1] Bulletin of the Geological Survey, No. 86. Correlation Papers. Archean and Algonkian. By Charles R. Van Hise. Washington, 1892.

Economic Geology of the United States.[3]—In a volume of 509 pages, Mr. R. S. Tarr has compiled the information, up to 1893, concerning the mineral resources and industries of the United States. Although intended as a text-book to supplement a course of lectures at Cornell University, the style of the writer makes it of general interest. Part I treats of the common rock and vein-forming minerals and ores, the rocks of the earth's crust, physical geography and geology of the United States, origin of ore deposits, and mining terms and methods. Part II takes up metalliferous deposits in detail. The statistics are almost all compiled from the standard sources. An appendix contains the literature of the subject and a list of authors and works referred to in the text. A number of cuts illustrate the text.

Woods' Invertebrate Paleontology.[4]—This crown octavo of 222 pages, by Professor Henry Woods, is the first of the Cambridge Natural Science Manuals. In it the author presents a condensed account of the invertebrate paleontology necessary for a geological student, limiting himself for space reasons to a consideration of those fossil animals that are most useful to a stratigraphist. Each group is discussed according to the following general plan: first, its general geological features; secondly, the classification, characters and time range of the geologically important genera; thirdly, the distribution of each group. The text is abundantly illustrated and well indexed.

[3] Economic Geology of the United States with briefer mention of Foreign Mineral Products. By R. S. Tarr. New York, 1894. MacMillan & Co., Publishers.

[4] Elementary Paleontology for Geological Students. By Henry Woods, B. A., F. G. S. Cambridge, 1893.

General Notes.

PETROGRAPHY.[1]

Zirkel's Petrographie.—The second volume of Zirkel's treatise on Petrography[2] has recently appeared in America. It treats with such fulness of the massive rocks that an epitome of its contents is out of the question in this place. The volume discusses the composition, mineral and chemical, the structure and the distribution of the various types of the eruptive rocks with a thoroughness found only in German text-books. The descriptions of their important occurrences will be especially valuable to the student who has not a library at his disposal; and to the investigator, the large and accurate lists of references scattered through the book are very welcome. Many petrographers will differ with the author as to the importance and desirability of some of his types, and others will find fault with him concerning some of his theories, as, for instance, that of the origin of olivine aggregates in basalts. The volume is, however, on the whole quite free from theoretical discussions. While it loses something of its interest in consequence of this lack of theory, the book gains the confidence of the reader, who desires more particularly an account of the work done in the different provinces, where the rocks in which he is interested are to be found.

Inclusions in Volcanic Rocks.—Two articles on the petrographical changes affected by the partial or entire solution of foreign inclusions in volcanic rocks have recently appeared. The first is an essay by Dannenberg,[3] and the second a volume of 710 pages by Lacroix.[4] Dannenberg's article treats more particularly of the inclusions in the Siebengebirge basalts, andesites and trachytes. Zircons, corundum, magnetite, pyrite, feldspar. sillimanite, quartz, sandstone, schists and granite were found included in both basic and acid rocks of the region. Those inclusions that were most similar to the including rocks suffered much less alteration than those that differed most in chemical composition from the lavas. The aluminous compounds frequently yielded

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] F. Zirkel: Lehrbuch der Petrographie, Leipzig, 1894, pp. iv and 941.

[3] Min. u. Petrog. Mitth. XIV, p. 17.

[4] Les Enclaves des Roches Volcaniques, Macon, 1893, pp. 710, pl. vii, fig. 84.

spinels as a consequence of the contact action. In many instances different combinations of inclusion and including rocks gave rise to the same new products, so that it is difficult to discover the exact law governing the changes. In the basalts the principal inclusions consisted of single minerals, while in the more acid rocks they comprised largely rock fragments—a fact probably attributable to the different solvent powers of the including material. Lacroix's volume is a nearly complete treatise on the subject of which it treats, which is limited, as the title indicates, to the study of inclusions in volcanic (effusive) rocks only. The author separates inclusions into two classes. The first comprises fragments of an entirely different nature from that of the enclosing rock, as granite in basalt. These he calls enallogenous (enclaves énallogènes). The second class comprehends inclusions more or less similar in composition to the including material. These he terms homogeneous inclusions (enclaves homoeogèues). The second class embraces aggregates formed by segregation and by liquation, as well as true inclusions. The including rocks are also separated into two groups, the basaltic and the trachytic. In the first part of the book the enallogenous inclusions are discussed with great thoroughness. In the second part the homogenous inclusions are studied. In a third part are collected the general conclusions. Chapters are devoted to each class of rocks and divisions of the chapters to the character of the inclusions in them. Resumés and paragraphs embracing the results of the studies are scattered through the volume at convenient intervals, and a geographical index concludes the book. The number of discoveries made by the author in the course of his work is too large for discussion in this place. The book bears evidence of thoroughness throughout. It is an excellent contribution to the subject of contact action.

The Basic Rocks of the Adirondacks and of the Lake Champlain Region.—Kemp[5] gives a brief account of the coarse basic rocks of the Adirondacks of which the well known norite is a phase Associated with the norite are anorthosites, gabbros and olivine gabbros, all of which are more or less schistose. The anorthosites are crushed, and where the shattering has been most intense their plagioclase has been changed to a fine grained aggregate, thought to be saussurite. Augite and brown hornblende are present in these rocks, but not in large quantity. Garnets are always present. The more basic gabbros are dark rocks, whose plagioclase has a greenish tinge due to the abund-

[5] Bull. Geol. Soc. Amer. 5, p. 213.

ance of dust inclusions scattered through it. The special features of the gabbros are the reaction rims around pyroxene and magnetite. A zone of small brown hornblendes is often found between the first named mineral and plagioclase. Between magnetite and feldspar are usually three zones, of brown hornblende, pink garnet, and quartz, respectively, the last named mineral occurring nearest the feldspar. Sometimes the order of the zones is different. The quartz may appear within the zone of garnets, in which case the latter mineral may replace the feldspar in part, as alternate lamellae between lamellae of plagioclase. The gabbros contain large bodies of titaniferous magnetite. On the contact of the eruptive with limestone the latter rock has been crystallized and silicified. The same author, associated with Marsters,[6] has described the trap dykes of the Lake Champlain region as camptonites, fourchites, monchiquites and bostonites.

The Augite Granite of Kekaquabic Lake, Minnesota.—The granite of Kekaquabic Lake in Northeastern Minnesota, occurs in granitic and in porphyritic phases, according to Grant.[7] In both varieties the constituents are quartz, anorthoclase and other feldspars, augite, a little hornblende, biotite, apatite and sphene. The granitic variety needs no further mention. In the porphyritic phase the quartz and feldspar form a fine grained groundmass in which lie phenocrysts of feldspar and augite. An analysis of this feldspar, whose density is 2.58–2.62 gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	Total
67.99	19.27	.82	.75	.02	3.05	6.23	.90	= 99.03

The augite comprises from 5–20 per cent of the rock. Its tint varies from green to colorless, the lighter colored portion often lying within a darker outer zone. Analysis of the augite yielded:

SiO_2	Al_2O_3	Fe_2O	FeO	CaO	MgO	K_2O	Na_2O	H_2O	Total
53.19	2.38	9.25	5.15	17.81	9.43	.38	2.63	.01	= 100.23

The rock, which is an augite soda-granite, has the following composition:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	P_2O_5	Total
66.84	18.22	2.27	.20	3.31	.81	2.80	5.14	.46	tr	= 100.05

---

[6] Bull U S. Geol. Survey, No. 107.

[7] Amer. Geol., XI, 1893, p. 383.

Petrographical News.—In a series of articles recently published Vogt[8] discusses the formation of oxides and sulphide ores around basic eruptive rock bodies, describes all the known occurrences of the nickel sulphides with reference to their mode of origin, and reviews critically the literature treating of the differentiation of rock magmas. He shows that the nickel ore deposits that are peripheral must be due to differentiation of rock magmas. He further shows that the laws governing the processes of differentiation are very complicated and that neither Soret's principle nor any other single physical or chemical principle will satisfactorily explain the phenomena.

Dr. G. H. Williams[9] reports the occurrence of volcanic rocks at many localities in the eastern crystalline belt of North America. The rocks in question comprise tuffs, glass breccias, devitrified obsidians and fine grained crystalline flow rocks with many of the characteristics of modern lavas. All these have heretofore been regarded as sedimentary in origin by most of the geologists who have studied them. The author gives his reasons for concluding that they are volcanic, and declares that, not before their true character is recognized will the structure of the crystalline areas of the Appalachians be correctly understood.

Lang[10] discusses the conclusions of Rosenbuch[11] with respect to the chemical nature of the crystalline schists, and criticizes Linck's principles governing the mineralogical composition of eruptive rocks. In his article, which is well worth reading, the author shows conclusively that the mineral composition of rocks is not determined by their chemical composition.

[8] Zeits f. prakt. Geol., 1893, Jan., April.

[9] Journ. of Geol., Vol. 2, p. 1.

[10] Min. u. Petrog. Mitth., XIII, p. 496.

[11] Cf. American Naturalist, 1891, p. 827.

GEOLOGY AND PALEONTOLOGY.

The Cambrian Rocks of Pennsylvania from the Susquehanna to the Delaware.—Mr. C. D. Walcott has published his notes on the basal quartzites and limestones of the lower Paleozoic rocks that extend across Pennsylvania, from the Susquehanna river to the Delaware river, and across New Jersey to Orange County, New York, on the north, and into Chester County, Pennsylvania, on the east. The paper is concluded with the following brief summary of the results of the author's observations:

"The discovery of the Olenellus or Lower Cambrian fauna in the Reading sandstone practically completes the correlation of the South mountain, Chickis and Reading quartzites of Pennsylvania, and establishes the correctness of the early correlations of McClure, Eaton, Emmons and Rogers. They all considered the basal quartzite as the same formation from Vermont to Tennessee; and the discoveries of recent years have proven that the basal sandstone of Alabama, Tennessee and Virginia (Chilowee quartzite); Maryland, Pennsylvania and New Jersey (the Reading quartzite); New York and Vermont (Bennington quartzite); were all deposited in Lower Cambrian time, and that they contain the characteristic Olenellus fauna throughout their geographic distribution. The superjacent limestones carry the Olenellus fauna in their lower portions, in northern and southern Vermont, eastern New York, New Jersey and Pennsylvania. To the south of Pennsylvania the lower portions of the limestones appear to be represented by shales, and the upper and middle Cambrian faunas are found in the lower half of the Knox dolomite series of Tennessee, and they will probably be discovered in the same series in Virginia and Maryland, when a thorough search is made for them. The same may be predicted, but with less assurance, for the northern belt of limestone crossing Pennsylvania and into New Jersey, as the limestones between the Olenellus zone and the Trenton zone represent the intervals of the middle and upper Cambrian and lower Ordovician, or the Calciferous and Chazy zones, of the New York section. The working out of the details of this section in southeastern Pennsylvania is an interesting problem, left for solution to some geologist who has the necessary paleontologic training and who will not be discouraged by the prospect of a good deal of hard work before the desired result can be obtained."

"The problem of where to draw the line in this series of limestones, on a geologic map, between the Cambrian and the Ordovician, is one that will seriously embarrass the geologist, but I anticipate that either lithologic or paleontologic characters will be discovered by which the two groups can be differentiated. If not, the limestones must be colored as one lithologic unit or formation and the approximate line of demarkation between the Cambrian and Ordovician indicated in the columnar section accompanying the legend of the map."

Geology of Bathurst, New South Wales.—Bathurst is the centre of a region of considerable geological importance, and geologists are indebted to Mr. W. J. C. Ross for a detailed account of the formations of that district. The Bathurst Plains is a tract of undulating country surrounded by hills. The Plains form an extensive granite area estimated at 450 square miles, while the hills are of metamorphic rock, probably all Silurian. To the east of Bathurst they are backed by an escarpment of Devonian quartzites and sandstones. A few of the western hills are capped by basalt resting on Gravels, indicating volcanic eruptions in the district.

In discussing the age of the Granite, the author states that it is newer than the Silurian, but its relative age with respect to the Devonian is uncertain. He is inclined to think that there have been two intrusions, one subsequent to the Silurian and prior to the Devonian; and the second disturbed the Devonian strata, converting the sandstones into quartzites. A series of veins which traverses the central mass of granite is probably connected with the second intrusion. (Quart. Journ. Geol. Soc., Vol. L, 1894.)

Fossil Tipulidae.—In a paper on Tertiary Tipulidae recently published by Samuel H. Scudder, the author describes twenty-nine new species of 10 genera of Limnobinæ and twenty-two new species of 5 genera of Tipulidæ from Florissant, Colorado, only. From facts now known Mr. Scudder concludes that three principal insect localities in western Colorado and Wyoming are deposits in a single body of water, the ancient Gosiute Lake. To the fauna of these deposits he applies the term Gosiute Fauna, in distinction from the Florissant or Lacustrine Fauna in central Colorado. No single species of the Lacustrine fauna occurs in the Gosiute, and among the few genera found in two of the localities of the Gosiute fauna, the species of each locality are distinct from those of the other.

As a summary of general results obtained from the study of these remains, Mr. Scudder submits the following propositions:

1. The general facies of the Tipulid fauna of our western territories is American and agrees best with the fauna of about the same latitude in America.

2. All the species are extinct.

3. No species are identical with any of the few described European tertiary Tipulidae.

4. Of the Florissant genera, eight out of fifteen are extinct.

5. All the existing genera, except Cladura (American) of the American tertiaries are genera common to the north temperate zone of Europe and America, and are generally confined to those regions. Hence a similar climate is inferred; at least, there are no certain indications of a warmer climate.

Mr. Scudder is fortunate in having such beautifully preserved specimens with which to illustrate his paper. The delicate appendages, the markings and venation of the wings, and even the facets of the compound eyes are shown. The reproduction of the drawings of such delicate fossils reflects great credit upon the lithographer. (Proc. Amer. Philos. Soc., Vol. XXXII.)

Diatoms.—A deep-sea dredging in the Atlantic Ocean, off Delaware Bay, yielded 145 species of diatoms comprising not only marine forms, but a large number that are known to be fresh-water, and some found hitherto only in a fossil state. They were submitted to Mr. Albert Mann for examination, who reports an entire absence of new species. This fact, taken in connection with the depth of the water (318 fathoms), and the number and variety of species, leads the author to conclude that the deposit is composed of fine detritus sifted down upon the sea bottom, and conveyed there by currents from a considerable distance. A list of the genera and species is given, with references to the drawings and descriptions in published works by which they were identified. (Proceeds. U. S. Natl. Mus., 1893.)

Scott on Agriochoerus.—Some fragmentary skeletons of Agriochœrus, associated with the teeth from the White river bad lands of South Dakota, have confirmed a conjecture made by W. B. Scott that Artionyx O. & W. is a synonym of Agriochoerus Leidy. This new material permits Dr. Scott to determine the relation that Agriochœrus bears to the Oreodontidæ, by comparing the points of resemblance and

difference. These are given in detail and then summarized up in the following paragraph:

"In brief, the dentition and skeleton of Agriochœrus shows a large number of close correspondences with the oreodonts, and especially in those particulars in which that group differs from other artiodactyl families. On the other hand, there are significant deviations from the oreodonts, which are to be found more particularly in the structures correlated with the curious change in foot structure. It seems on the whole highly probable that the two families are not distantly related, especially if the somewhat intermediate character of Protoreodon be considered."

The conclusion arrived at by Dr. Scott as to the systematic position of Agriochœrus is that it is the last term in a succession of species which form a curiously specialized offshoot of the Oreodontidæ, its divergences from that family being principally the results of a change in the functions and uses of the feet. (Proc. Amer. Philos. Soc., Vol. XXXIII, 1894.)

The Atmosphere as a Factor in Dynamical Geology.—The line of inquiry pursued by Mr. J. A. Udden, concerning the work performed by the winds of the atmosphere is important since this subject has not received any searching attention from the geologists of this country. The author states a series of laws which appear to govern aerial erosion, transportation and sedimentation in general, and gives the data from which these laws are formulated. The similarities and differences of wind and water erosion and transportation are pointed out, and estimates, based on experiments, of the relative values of the work accomplished by each. From these considerations important deductions are drawn. (1) Since the velocities in the atmosphere are greater than those in water, the distances over which materials may be transported in it are correspondingly greater. (2) The depth of the aerial ocean renders it but little dependent in its movements on the elevations of the land. (3) While the conditions requisite for aerial erosion are limited to rather small areas on the land of the globe, deposition is much more general and widespread. Hence accumulations of atmospheric sediments are insignificant, as a rule, only accumulating in exceptional cases.

In conclusion, Mr. Udden suggests that from a dynamical point of view the wind theory would appear to furnish an adequate explanation of the occurrence of the loess in the Mississippi valley, at least as to

most of its phases, and gives the following facts as the basis of the suggestion:

"The recent denudation of the western plains, of the bad lands, and of the Cordilleran plateau is extensive enough to furnish the materials many times over. The different rocks in these regions, and the changeability of the atmospheric currents would combine to bring together and thoroughly mix a variety of materials, like those of which the loess is composed. The winds would naturally distribute over wide areas the heterogeneous but uniform mixture thus produced. When not taken close to exposures of other materials ninety-nine per cent. by weight, of the loess, is composed of particles below the size of .1 mm., and it contains only a small proportion of the finest materials common in clays and residuary earths, just as must be the case in an atmospheric sediment. It is best developed along the westernmost north-and-south drainage valley, that of the Missouri-Mississippi river. Almost everywhere it is heaviest nearest the water-courses. (Journ. Geol., Vol. II, 1894.)

Geological News. PALEOZOIC.—According to Mr. Winslow, the Coal Measures of Missouri occupy the whole western and northwestern portions of the State and embrace an area of 25,000 square miles. This region is a plateau of moderate elevation in which denudation has not progressed very far. The strata have a slight dip to the west. Their estimated maximum thickness is 1900 feet. The coals occur in basins of limited dimensions, and are chiefly bituminous in character. The beds range in thickness from one inch to about five feet.

MESOZOIC.—Forty-six additions have been made to the Cretaceous paleobotany of Long Island through the researches of Prof. Hollick. Of these nine are recognized as new species and are described and figured in the Bull. of the Torrey Botanical Club for 1894.

A new Plesiosaur, *Cimoliosaurus caudalis*, is described by Captain Hutton. The specimen, now in the Canterbury Museum, was found in the Cretaceous rocks near the Waipara river in New Zealand. It represents an animal about the size of *Pleiosaurus australis*, and is distinguished by the long and powerful tail. (Trans. New Zeal. Inst., 1893.)

Two new and interesting forms of Reptiles have been added to the group from the Elgin Sandstone described by Prof. E. T. Newton. One

is a small Parasuchian Crocodile, allied to Stagonolepis, and is named *Herpetosuchus grantii;* the other reptile Prof. Newton considers intermediate between the Dinosaurians and Crocodilians, and refers it provisionally to the Theropodous Dinosauria under the name *Ornithosuchus woodwardii.* (Proceeds. Roy. Soc., Vol. 54, 1893.)

Cenozoic.—The reports upon evidence as to glacial action in Australia are as follows: In Queensland and New South Wales, while there is both stratigraphical and biological evidence of a Pluvial epoch, it cannot yet be demonstated whether this epoch belongs to Plistocene or Pliocene time. For Victoria the evidence is equally unsatisfactory. In Tasmania and South Australia glacial action is demonstrated beyond a doubt by the researches of Mr. Johnson, Mr. Montgomery and Prof. Tate. In New Zealand, according to Captain Hutton, the evidence is confined to moraines, surface-till and "roches moutonnées." These indicate that during the ice-age there was an extension of the valley glaciers of the South Island, but there is no proof that they reached the sea. (Proc. Austral. Assoc. Adv. Sci., Adelaide Meeting.)

Mr. E. H. Williams' investigations of the extramorainic drift between the Schuylkill and the Delaware, result in the conclusion that the great moraine was formed immediately after the withdrawal of the ice from the Lehigh, and that it and the extramorainic deposits of the region were part of the same ice invasion, which was of recent age and short duration. (Bull. Geol. Soc. Am., Vol. 5, 1894.)

A tabulated list of the species of Coleoptera prepared by Dr. Scudder shows the effect of the Glacial Period on the present fauna of N. America. The list comprises the species east of the Rocky Mountains, with the exception of the "barren ground" of the high north, the immediate vicinity of the Rocky Mountains and the extreme south of Florida and Texas. West of the Sierra Nevadas the region is limited on the south by Los Angeles, and on the north includes Vancouver Island. In both of these areas, one of which may be termed the glaciated, the other the driftless, a comparison is instituted between the northern and southern regions of each to discover how many genera and species are common to both, and how many peculiar to each. In the eastern area the terminal moraine is the dividing line; in the western, the northern part of California. Finally, the results of these comparisons are balanced with each other. This, according to the

author, should be a guage of the effect of the Glacial Period upon the present faunal distribution of life. The tables indicate that on the whole the fauna of the East has nearly or quite recovered from its enforced removal from the northern States and Canada at the time of the Glacial Period, and that the Glacial influence is seen now only in minor features, such as boreal faunas lingering in favorable spots amid temperate surroundings, and the similar features induced by the latitudinal trend of our great mountain chains. (Am. Journ. Sci., Vol. XLVIII, 1894.)

Among the fossils recently found in the cavern de L'Herm (Ariège), France, are two that M. Boule considers worthy of special attention. The first is the lower jaw of a Glutton (*Gulo luscus*), the other the left inferior mandible of a *Felis* of enormous size. A comparison of the former with fossil Gluttons from other caverns in France, and the Ferest-bed of England, shows a difference in size only. This, M. Boule thinks, does not warrant the new species name, *Gulo spelæus*, applied to it by Goldfuss. M. Boule is opposed also to making a distinct species of the Cave Lion, preferring to consider it a varying form of *Felis leo*, and agrees with the English paleontologists in designating it *Felis leo* var. *spelæa*.

ZOOLOGY.

A New Etheostoma from Arkansas.—*Etheostoma pagei* sp. nov. Head 3½ in length of body; depth 4 to 4¼; eye 3½ in head; snout 3½; dorsal fin with nine or ten spines and 12 or 13 soft rays; anal spines 2; soft rays 7; scales 8–56 to 61–13.

Body robust, snout abruptly decurved but not blunt; mouth rather large terminal, maxillary reaching vertical from pupil; premaxillaries not protractile; lips thick; gill-membranes not connected; cheeks, opercles and breast naked; nape scaled: lateral line imperfect, developed on only about 12 scales.

Color of male: belly bright red, extending on sides to upper rays of pectoral fins; above the red is a yellowish band on the sides about as wide as diameter of eye; upper part of body olivaceous with darker markings, each scale being provided with a black spot, these making faint lateral streaks along the rows of scales, about 9 dark blotches on the side, resembling faint bars. Caudal and soft dorsal fins barred; pectorals faintly barred; anal ventrals plain; a dark numeral scale. The female has the underparts whitish, the sides olivaceous, much mottled with darker; otherwise as in the male.

Length, 2 inches.

Only the types known. Two specimens taken in the spring branch on the U. S. Fish Hatchery grounds, at Neosho, Missouri.

(Named for William F. Page, Superintendent of U. S. Fish Hatchery, Neosho, Missouri.)—S. E. MEEK.

Immunity of Salamanders in Respect to Curare.—In a paper read before the French Academy of Sciences, March 14th of this year, MM. C. Phisalix and Ch. Contejean demonstrated that salamanders have the power of resisting, to a remarkable degree, the action of certain poisons, particularly that of curare. A salamander weighing 28 grammes, was completely curarised only after receiving 43 millegrammes of curare, a quantity sufficient to poison 80 frogs. This immunity exists, but to a less degree, in the larva of the salamander, and to a still less degree in the tadpole of the frog. In order to study the cause of this immunity, the authors undertook a series of experiments. Their researches were conducted on the theory that there might exist a relation between the presence of venomous glands and this im-

munity, since the resistance of the toad is greater than that of the frog. In such a case, the immunity of the salamander would be due to the presence in its blood of a substance which would be an antidote or would neutralize the effects of curare. To verify this hypothesis, they innoculated a frog with the blood of a salamander, and obtained the following results:

1. The mixture of the blood of a salamander and curare in the proper proportions does not affect the frog.
2. The blood of the salamander provokes a physiological reaction antagonistic to curare.

These results show that the blood of the salamander contains a substance anti-toxic to curare; this substance exercises a protective action not only over the animal which secretes it, but also over the frog, in which it produces a true physiological reaction against curare.

The experiments of MM. C. Phisalix and Contejean were made in the laboratory of comparative physiology which is in charge of M. Chauveau, of the Museum of Natural History of Paris. (Revue Scientifique, 1st Sept., 1894.)

List of Ophidia found near Vincennes, Indiana.—I do not offer the following as a complete list of the snakes to be found in the neighborhood of Vincennes, but have included only such as I have taken myself. The region was once a very paradise for the herpetologist, but in the past few years many large swamps have been drained and cleared and animals once common are now rare, if not wholly exterminated. Still a more careful search would doubtless lengthen my list considerably.

The *Ancistrodon contortrix, Sistrurus catenatus* and *Crotalus horridus* were certainly once abundant, and are still *reported* as numerous, though I have never succeeded in finding a specimen of any one of them, and therefore do not include them in my list.

1. *Carphophis amoena* (Say), found under overhanging rocks.
2. *Farancia abacura* (Holb.), swamps.
3. *Bascanium constrictor*, numerous.
4. *Diadophis punctatus* (Linn.) found in rotten logs; rare.
5. *Liopeltis vernalis* (DeK.), abundant.
6. *Cyclophis aestivus* (Linn.), abundant.
7. *Storeria dekayi* Holb., among high grass in swamps.
8. *Storeria occipitomaculata* (Storer), stony ground.

9. *Coluber vulpinus* (B. & G.), pugnacious and regarded with superstitious dread.

10. *Coluber guttatus* (Linn.), found in dusty roads; enters yards and gardens at night.

11. *Coluber obsoletus* (Say), decidedly reddish from the blotches on base of scales. Have found it only on trees. Hisses with considerable force. A captive ate sparrows, but declined mice and eggs.

12. *Natrix leberis* (Linn.), "striped water snake."

13. *Natrix kirtlandii* (Kenn.), "spread head;" rare.

14. *Natrix sipedon* (Linn.), large; typical variety of our most common snake; variously colored. I found one that would flatten its head and anterior portion of its body like the *N. kirtlandii* or the *Heterodon platirhinus.* I have seen the two extremes of color, the reddish brown and the black spotted in the brood of one female captive.

15. *Heterodon platyrhinus*, common. A friend found a spotted and a uniformly colored specimen copulating and kept them, hoping to raise a family of cross breeds, but his neighbors threatened to prosecute him for keeping such venemous serpents in town, and at length some one broke open his box and killed the "deadly spreading adders." The snakes were strictly diurnal in their habits. They were voracious and preferred toads, but when pressed by hunger would eat frogs and small snakes.

16. *Ophibolus doliatus* (Linn.) common. A boy killed one in the woods, and I went out to examine it, and found beside the dead snake a live one of the same species. It was examining the body and showed fight when disturbed. Was it a mourner guarding the corpse, or a ghoul disturbed at its feast? I do not know.

17. *Ophibolus getulus*, less common.

18, 19, 20. *Eutainia saurita, radix* and *sirtalis*, the latter in great variety.

Mr. Robert Ridgway says that he was informed that the *Ancistrodon piscivorus* (LaC.) was abundant about Vincennes. He was probably misinformed.

The *Natrix sipedon* is called the "water moccassin" in this locality, and is much dreaded. A man near here is reported to have died recently from the effects of its bite, aud, strange to say, this story is believed.

The coral snake, *Elaps fulvius*, has been twice reported from this State, but no one in this locality, so far as I can learn, has ever heard of such an animal.—Angus Gaines.

38 Locust St., Vincennes, Ind.

Zoological News.—Mollusca.—According to MM. Bornet and Flahault, the chief cause of the disappearance of shells in quiet bays where they are not subject to wave action is the constant gnawing away of the calcareous matter by shell-boring algae and fungi. Ten genera of boring plants are described, and, in some cases, the life-histories are narrated. (Bull. Soc. Bot. France, t. 36.)

Pisces.—The Bull. U. S. Fish. Com. for 1892 includes a paper by Dr. Eigenmann on the viviparous fishes of the Pacific Coast of North America. The author reviews the Embiotocidae, gives a bibliography of the viviparous fishes, and a detailed accout of the development of Cymatogaster from fertilization to hatching, and the details of the development of the intestine and Kupffer's vesicle. Outlines of the post-embryonic development are also presented.

According to Dr. Gill, the proper generic name of the Tunnies is Thynnus. A discussion of the question is followed by a list of the synonyms. (Proceeds. Natl. Mus., Vol. XVI, No. 965.)

The same author has published a provisional arrangement of the families and subfamilies of fishes which includes the names of the proposers and modifiers of family names with the dates of naming. (Sixth Mem., Vol. VI, Natl. Acad. Sciences.)

Mammalia.—Dr. J. A. Allen calls attention to the cranial variations due to growth and individual differentiation, and instances the species *Neotoma micropus* as a case in point. In a series of fifty skulls of this species it would be easy to select extremes that depart so widely from the average in one or more characters that they might readily be supposed to represent distinct species. Hence the determination of the status of a species described from one or two specimens must depend upon the subsequent examination of a large amount of material bearing upon this and its closely-related forms. (Bull. Am. Mus. Nat. Hist., Aug., 1894.)

ENTOMOLOGY.[1]

Biology of the Glowworm.—Some interesting observations on the New Zealand Glowworm (*Bolitophila luminosa*) are recorded by A. Norris.[2] The larvæ secrete a mucus, on which they slide, leaving a mucus track like the snail. The mucus is also used to make luminous webs. "When the larva is making a fresh web, it raises its head and the first four or five segments in the air, and reaches round about till strikes something. It then draws its head back a little way, thus making a very fine thread of mucus. It then passes it to the thick mucus on the first segment, then slides out a little way and makes another thread on the other side in the same way, fastening each to the thick mucus on the body. When it has made a sufficient number of these braces, it begins to make the strings of beads which hang downward from these braces by gliding out on the braces and lowering its head and about half the body. It then works its head up and down as if to vomit. You can see the mucus gathering on the body. Then it draws its head right back into the first two segments, as if it were turning inside out. It then catches hold of the mucus on the edge of the segment and forces it forward. Now the head is out straight, with a large drop of mucus all round it, like a drop of water. Then it draws its head gently out of the mucus, thus making a short, fine thread from it. It then makes another drop and another short thread; then a drop and so on until it has made several of these pendents of beads, which vary in length. I have seen them from one inch to four or five inches." In the small caves where the larva lives, these webs reflect the light from the shining glowworm.

Mr. Norris believes the webs are formed to entangle insects and Crustacea, as he has found many of these dead in the webs, and some were hollow as if the body contents had been eaten. "When the insects are alive, the larva may be seen smothering them with mucus." One was also seen actually feeding on the inside of a Crustacean.

Embryonic Development of Tortrix.—As a result of recent studies of *Tortrix ferrugana*, J. W. Tutt says:[3] "It appears certain that

---

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Ent. Mon. Mag., Sept., 1894.

[3] Ent. Record, V, 215, Sept., 1894.

there are in its embryo four distinct cephalic segments, which, in the early stages of embryonic development are large (compared with the other segments which are developed later), and are made still more distinct by the possession of buds or processes. As development goes on, these four segments get welded together, and become not only proportionately, but absolutely smaller than at first. When the abdominal segments are in course of development, there certainly appear to be eleven of them. The three thoracic segments are, in the early stages of development, large and almost circular, and the next segment (1st abdominal) is of the same character, looking at this time much more like a thoracic than an abdominal segment, though it has, of course, no appendages. The eye spots in this species are remarkably conspicuous as two reddish patches, and become apparent at about the same time that the abdominal segments first show. As development proceeds, the cells of the developing *T. ferrugana* appear to be stained here and there with red patches, especially along the ventral area of the alimentary canal, but differently distributed in different examples. These afterward spread over the whole of the embryo." It was suggested that this color was connected with the skin. The thoracic legs develop when the embryo begins to show segmentation. The embryo is then somewhat curved, "with the head slightly bent round toward the anal extremity, but with the legs outside, *i. e.*, the larva is bent back upon itself so as to form a curve agreeing roughly with the curvature of the shell, with what afterwards becomes the ventral surface of the larva outside and the dorsum towards the centre. The embryo then gradually changes its position, the anal segments curling around and being pushed by the growth of the preceding abdominal segments slowly up the ventral surface of the larva whilst the dorsum gets pushed out, as it were, towards the centre of the egg. During this process the embryo becomes shaped something like the letter S, the movement continuing until a complete reversal of the embryo has been affected."

The Rabbit Bot Fly—Cuterebra cuniculi Clark.—We are greatly indebted to Mr. Percy Selous, of Greenville, Mich., for specimens, notes and drawings of the rabbit bot fly, *Cuterebra cuniculi*. The larva of this species is quite often taken from the rabbit, though few persons are successful in rearing the fly from the larva, and Mr. Selous is to be congratulated on his success.

The notes of Mr. Selous on the rearing of the bot are as follows: 'The ripe larva dropped from a rabbit I shot last September. The

grub was between the fore legs rather high up, and when expelled, the pocket in which it had lived had just the appearance of the interior of the anus in mammals. I took the grub home and let it burrow into a box of earth from which the fly emerged, something like what I have shown in my sketch, on the 22d of May. As a naturalist, I am deeply interested in such matters as this, and the fact that I have been able to follow my bent in South Africa, South America and many other countries does not tend to make me less so."

The grub, as shown by Mr. Selous in the accompanying drawings, is over an inch and a half long and nearly an inch broad. The pupa case is very thick and heavy, with blunt, thick-set tubercles covering the outside of it. The fly has the head, legs, ventral region and all of the abdomen, except the first segment, black. The thorax and the first segment are thickly covered with fine silken yellow hair. The wings are dark and smoky.

This species of grub is quite common in the front quarters of rabbits this time of the year, and no doubt if more hunters and naturalists knew of its presence in the rabbit and how to save and rear the grub, more of the flies might be reared. Mr. Selous has made a start; who will follow ?—G. C. DAVIS. Agr'l College, Mich.

Insects' Vision.—Mr. A. Mallack adds another paper to the voluminous literature of vision in insects.[4] His observations and calculations, as we learn from the "Journal of the Royal Microscopical Society," have led him to conclude that "Insects do not see well; at any rate, as regards their power of defining distant objects, and their behaviour, favors this view. They have, however, an advantage over simple-eyed animals in the fact that there is hardly any practical limit in the nearness of the objects they can examine. With a composite eye, the closer the animal the better the sight, for the greater will be the number of lenses employed to produce the impression. In the simple eye, on the other hand, the focal length of the lens limits the distance at which a distinct view can be obtained. Of the various forms of insects examined, the best eye would give a picture about as good as if executed in rather coarse wool-work, and viewed at a distance of a foot."

Chinch Bug Diseases.—Professor F. H. Snow makes an elaborate report[5] of his recent extended experiments with the fungus Sporo-

---

[4] Proc. Roy. Soc. Lond., LV, pp. 85–90.

[5] Univ. of Kansas Exp. Station, Third Rept., 1894.

trichum which causes a fatal malady of chinch bugs. More than three thousand experiments are reported, more than half of which were believed to be successful. The great difficulty in the practical use of the fungus was the dry weather, during which no progress could be made.

Greenland Insects.—In reporting on a small collection of Microlepidoptera from McCormick Bay, Professor C. H. Fernald remarks:[6] "One of the most interesting features of this small collection is the very dark color of the insects. The specimens of *Laodama fusca* and also of *Pyrausta torvallis* are much darker than any I have ever seen before, either of those taken in New England or Labrador, but when we recall that Mr. Meugel states that they rest on the lichen-colored rocks, we have not far to seek for the cause of this dark color." These lichens are dark brown or black, and the laws of natural selection would lead to the establishment of a dark race through the elimination of the light-colored individuals. Professor Fernald describes one new species —*Sericoris mengelana.*

Habits of Larval Coleoptera.—F. M. Webster reports[7] that larvæ of *Leptotrachelus dorsalis* Fab. feed on larvæ of *Isosoma tritici* Riley, and pupate in wheat stubble, after plugging up open end. The larva of *Phalacrus politus* Mels. develops in smut of rye and Indian corn. A female *Neoclytus erythrocephalus* was seen ovipositing in trunk of dead apple tree, and *Bruchus mimus* Say was reared from seeds of *Cercis canadensis.* The larva of *Disonycha caroliniana* Fab. feeds on foliage of *Portulaca oleracea,* and *Apion segnipes* Say develops in pods of *Tephrosia virginiana.*

Biology of the Horse Bot.—From observations on the eggs of the common horse bot fly, Professor H. Osborn reaches the following conclusions:[8] "(1) That the eggs do not hatch, except by the assistance of the horse's tongue. (2) That hatching does not ordinarily occur within ten or twelve days, and possibly longer, or, if during this period, only on very continuous and active licking of the horse. (3) That the hatching of the larvæ takes place most readily during the third to fifth week after deposition. (4) That the majority of the larvæ lose their vitality after thirty-five to forty days. (5) That the larvæ may retain their vitality and show great activity upon hatching

---

[6] Ent. News, V, 132.

[7] Ent. News, V, 140.

[8] U. S. Dept. Ag., Div. Ent., Bull. 32, p. 48.

as late as thirty days after the eggs were deposited. (6) That it is possible, though not normal, for eggs to hatch without moisture or friction. (7) That in view of these results, the scraping off of the eggs or their destruction by means of washes will be very effective, even if not used oftener than once in two weeks during the period of egg deposition, and probably, that a single thorough removal of the eggs after the period of egg deposition has passed, will prevent the great majority of bots from gaining access to the stomach."

PSYCHOLOGY.

Subjective Defense in the Lower Animals.—In this paper I use the word "defense" in its broadest sense, not only as the antethesis of offence, but in the sense of protection. The instinct of defense or self protection is greatly developed in the lower animals, so much so, that the observant naturalist finds evidence of it even in microscopic organisms.

On one occasion I opened the burrow of an itch insect (*Acarus*), and allowed the serum to float out the little parasite which dwelt therein. I could, with the assistance of a good French lens (X 15 diameters) closely see it moving along on the surface of the skin. I touched it with the point of a needle, and at once it stopped all motion and feigned death. In a few moments the little animal regained its feet and slowly moved off, only to again feign death as soon I touched it with the needle. This habit of letusimulation (*letum*, death, and *simulare*, to feign), I have noticed in much lower animals, and am convinced that they make use of this strategy for the purpose of self-protection.

A minute fresh water animacule (rhizopod) retracts its hair-like feet, feigns death and sinks, whenever its enemy, a water louse, approaches it. I have witnessed this occurrence on several occasions, and have, likewise, seen Rhizopoda return to their feeding-grounds as soon as their enemy has disappeared. A fresh-water worm practices letusimulation when approached by the giant water-beetle, and many of the microscopic infusory animalcules likewise make use of the same sagacious subterfuge when surprised by their enemies. Death-feigning is practiced by most of the slow-moving beetles, especially is this noticeable in the tumble-bug and bombardier-beetle. This last-mentioned insect, notwithstanding its disgusting odor, is the favorite food of some of the birds, noticeably, the jay and the cardinal. They will not touch it if killed and offered to them; numerous experiments have taught me that these birds regard it as unsuitable food unless taken alive. There is, probably, some *post-mortem* change in the juices of the beetle, which renders it unpalatable. The object of letusimulation in this beetle is made perfectly obvious. In a paper on "Animal Letusimulants," published in the March number of *Atlantic Monthly*, I account for the origin of death-feigning in animals, as follows: "Most animals are slain for food by other animals: there is a continual struggle for existence. Most of the carnivora and insectivora prefer freshly killed food

to carrion. It is a mistake to suppose that carnivora prefer carrion, though the exegencies of their lives in their struggle for existence often compels them to eat it. Dogs will occasionally take it, but sparingly, and apparently as a relish, just as we ourselves eat certain odoriferous cheeses. Carnivora and insectivora would rather do their own butchery; hence, when they come upon their prey seemingly dead, they will leave it alone and go in search of other quarry, unless they are very hungry. Tainted flesh is a dangerous substance to go into most stomachs, certain ptomaines rendering it, at times, virulently poisonous. Long years of experience have taught this fact to animals, therefore, most of them let dead or seemingly dead creatures severely alone."

The larvæ of many of the moths and butterflies are pronounced letusimulants. In fact, I may say that all edible larvæ practice this cunning trick. Take a caterpillar in the fingers, or touch it with a stick, and it will at once curl up and feign death. They invariably assume that shape which *rigor mortis* occasions in real death. Mr. George D. Mattingly, of Owensboro, Ky., related to me the following instance of letusimulation in a caterpillar: This larva had fallen accidently into a conical depression in a sand-heap. It attempted to crawl up the north side of the pit, but, owing to the rolling of the sand beneath its feet, slipped back. It then tried the west side, and almost reached the top. Here, however, it dislodged a lump of agglutinated sand-grains, and rolled, together with the lump, to the bottom of the hole. The caterpillar, imagining the clod of sand to be an enemy, at once curled up and feigned death. It remained quiescent for several minutes, then tried the south side, mounted safely to the top, and went on its way rejoicing. The fact that this larva tried three different routes before reaching the top, shows a high degree of conscious determination. Many of the thousand-legs have this habit, and practice it whenever the occasion demands. The toad is a gifted letusimulant; when it sees that it cannot escape its enemy, it ducks its head, draws in its legs close to its body, and feigns death. It may be turned upon its back, or thrown to some little distance, or handled freely, yet it will give no sign of life, unless pain be inflicted.

Some of the snakes have acquired this habit, notably the moccasin (*Ancistrodon*). Last August I discovered a moccasin in an open field where there were no sheltering rocks, bushes, weeds, etc. I teased it for quite a while with my stick, driving it back whenever it attempted to escape. Suddenly it bent its body backwards and seemingly inflicted a severe bite on its own back. Immediately it turned over on its back, belly upwards, to all appearances dead. I retired some little

distance and seated myself on the ground. After five or six minutes the snake turned upon its belly and glided rapidly away.

Mr. John Cheatham, of Owensboro, Ky., informs me that on September 23, he and Mr. John Harrison came suddenly upon a black or blowing-viper in a field. Mr. Harrison remarked that he could make the snake commit suicide; whereupon, he picked up a long stick and began to annoy it, driving it back whenever it endeavored to escape. In a few moments "the snake bent back and drew his widely open mouth violently along his body as if endeavoring to rip himself open. He then turned upon his back and died at once." This act of letu-simulation was so perfect that Mr. Cheatham and friend walked away, thoroughly convinced that they had seen a suicide enacted. It is hardly necessary to remark that the snake in question is perfectly harmless, having neither fangs nor poison glands. Many of the higher animals make use of the simulation in order to deceive their enemies or their prey.

The Criminal Skull.—I give a figure of a model in clay of the skull of Jeff. Diggs who died at the age of fifty, having passed, according to his own statement, thirty years of his life in reformatories, workhouses, jails and penetentaries. This model is made to scale and is

The Criminal Skull.

exact in every particular. A Photograph of the original skull does not bring out the detail, hence I made the model in clay. It should have accompanied the text of "The Recidivist," American Naturalist, June, 1894, but an injury to my right hand prevented a completion of the model in time.

POINTS TO BE NOTED.

1. Flattening of the cranial arch.
2. Shallowness of brain-pan.
3. Dolichocephalism.
4. Prognathism.
5. Enlargement of orbital arches.
6. Smallness of orbicular cavities.
7. Highness of cheek bones.
8. Bowing of zygoma.
9. Sagging of occiput.
10. Heaviness and projection of lower jaw.
11. General asymetry of skull.
12. Resemblance to the prehistoric skull of the Man of Spy.

See "The Recidivist" American Naturalist, June, 1894.

JAS. WEIR, JR., M. D.

The Habits of Amblystoma opacum.—I once secured a number of marbled salamanders (*Amblystoma opacum*), and kept themin a small enclosure where they lived under chunks of wood. They did not curl up as they are said to do, but lay stretched out, showing but little sign of life. Their food was larvæ and earthworms; I believe they will not eat flies nor ants. They are so soft, weak and helpless, that I thought that they could not dig deeper than merely sufficiently to hide themselves, but, out of deference to the opinion of Mr. Nicholas Pike, who says that they will burrow to a depth of three feet, I sunk a board two feet deep around their enclosure. I was absent for a time, and returned to find my salamanders missing. On digging carefully, I found unmistakable signs of their burrows extending beneath the sunk board. They had burrowed out and escaped, corroborating two feet of Mr. Pike's story.—ANGUS GAINES.

Habits of Ophibolus getulus.—Early in July I captured an *Ophibolus getulus*, a small but very fine specimen, answering perfectly to the description of the type given by Dr. O. P. Hay, in the Seventeenth Annual Report of the Indiana Geologist.

The little reptile fought fiercely when first picked up, but was perfectly docile the next day. I kept him in an enclosure with a number of other snakes of various species, but he appeared to dislike their society and appeared reluctant to share their bed of loose cotton. He refused all food and took no notice of the earthworms, insects, minnows and small frogs and toads with which my other snakes were fed, and paid no attention to a *Natrix sipedon* much smaller than himself. When placed in a box with a large number of small toads, he appeared frightened and tried to escape. Acting upon a suggestion offered by Professor Cope in his article on "Critical Review of the Characters and Variations of the Snakes of North America," I kept him supplied with a saucer of milk, of which he took no notice.

After he had been in my possession for 25 days, I captured a *Eutænia radix* which I put in the same enclosure. The other snakes paid no attention to the newcomer, but the *Ophibolus* roused at once, as if scenting a natural enemy, and seized the *Eutænia*. The fight was long and fierce, for the *Eutænia* was strong and active, and was five inches longer than his assailant, but the *Ophibolus* gained the victory and undertook the seemingly impossible feat of swallowing his victim. This task occupied the whole night, but he actually succeeded in swallowing the snake five inches longer than himself. This very hearty meal distorted him beyond recognition, and he gave no signs of life except by a slight twitching of the tail. After an absence of some 40 hours I revisited my terrarium, and found that he had disgorged his prey and resumed his proper shape.

Since that time the *Ophibolus* has taken no food, though he is still strong and active; his spots, however, which were originally of ivory whiteness, have assumed a sulphur yellow hue.

I tried placing a looking-glass in my terrarium, and the *Ophibolus* showed signs of excitement at the first sight of his reflection, but afterwards paid no attention to it.

My *Ophibolus getulus*, 12½ inches long, after going fifty days without food, except the one snake which it subsequently disgorged, killed and ate a *Natrix sipedon* over eight inches long, and is doing well.

—Angus Gaines.

ARCHEOLOGY AND ETHNOLOGY.[1]

Indian Corn in Italy.—Some Italian Naturalists like Bonafous (Hist. Nat. Agric. et Economique du Mais, Paris and Turin, 1836) have supposed that Indian Corn (Zea Mays) had grown in Asia or Africa before the Spaniards found it in America, but De Candolle (L'Origine delle piante Coltivate, Milan 1883, p. 519) believes that it came into the Old World from the New after the discovery by Columbus, and that Rifaud, who in 1819 found maize in an Egyptian tomb at Thebes, was deceived by an Arab.

Signor Goiran, of Verona, supposes that the plant was first largely cultivated near Verona about 1647, and Signor Anelli, the inventor of "Anellis maize-bread," informs me that it was not used for human food in the Milanese until about 1817. Harschberger in his recent important investigation of the history of the grain (Zea Mays—A Botanical Study, Philadelphia, 1892) while tracing the source of the American grain to Southern Mexico does not believe in its extra American origin, but whether we may suppose it to have grown in any corner of the Old World before 1492 or not, there is no question that the Spanish discoverers brought specimens of it from America to where it was noticed in cultivation near Seville about 1527. How it got into Italy from Spain, (granted that it came thence) whether directly, or by the roundabout way of Arab commerce through Morocco, Africa and the Levant, no one seems to have informed us, though if by the latter route, we may guess that it found its way into Lombardy through Venice.

However and whenever it appeared on the Lombard plain, the well preserved architectural decorations, frescoes, paintings and book illuminations of the fifteenth and sixteenth centuries in Italy might throw an unexpected light upon the date and direction of its first importation. The frescoes of Mantegna (1451–1517) often adorned with borders of plants and flowers might reveal maize. There is no maize, I am informed, among the plants and fruits painted on the leaf margins of the magnificent 15th century Missal known as the Breviario Grimani by Hans Memling (died before 1499) at the library in Venice; and I failed to find signs of the use of Indian Corn in the farmyard pictures of Jacopo Bassano (1510–1592) at Venice and Verona, or in the throng of stooping figures and animals by him known as "The Fair" at Bassano, where

---

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

the turkey appears then as new and as American as maize. I found it, however, abundantly used in the Stucco ceiling decorations (by Vittorio, middle of 16th century) of the Villa Masser near Castel Franco.

If there remains any doubt as to the genuine antiquity of the grains in Rifaud's Egyptian tomb no better evidence for or against the American origin of the plant now grown in Europe could be looked for than what these unransacked pictures and ornaments may offer, where at slight pains and by a turn of the head, any traveller will settle the question beyond all dispute if he discovers maize in color or stone before 1492.

While common parlance in the Old World has so often held to a geographical name for the strange grain, dubbing it in Lorraine "Roman grain," in Tuscany "Sicilian grain," in Sicily "grain of India," in the Pyrenees "Spanish grain," in Provence "Barbary or Guinea grain," in Turkey "Egyptian grain," and in Egypt "Syrian grain," these Folk names have seemed by implication to deny, in every case, an American origin to the plant. But the fact in De Candolle's opinion proves no more than that the English name "Turkey" has appeared to deny an American parentage to the familiar *Meleagris gallopavo.*

According to Professor Keller of the University of Padua, the human consumption of maize ceases south of Bologna, and in my conversations with townspeople a slight notion of something ridiculous seemed to attach to the grain, as of a food fit for hogs and cows, rather than men. Notwithstanding this, some of the peasants eat maize in the common form of Polenta (boiled mush) to such an extent in the Novarese, Bergamasco, Milanese, Comasco, Bresciano, and Tremonese, and in Mantua, Veneto and Vercelli[3] that a sickness called Pelagra, showing itself in shrunken skin, emaciation, dizziness, intense thirst, and a desire to plunge into pools of water, is the result.

Leaving out the alcohols, oils, colors and glucose extracted from Italian maize in recent years, the most considerable and important of all the human uses of the grain in Italy is

(1) *Polenta,* the universally mill ground meal boiled with salt and water for half an hour, large doughy loaves of which, saffron yellow or white, can be found in almost any peasant's cupboard from Venice to Piedmont.

Sometimes cut slices of it are found, as I saw them at Venice, fried, like American fried mush.

---

[3] For this and the following information as to Anellis Bread and Pane Mistura I am indebted to the Rev. Signor Anelli of Monza.

Now and then a little maize meal goes with farina, salt and water into a soup and you have

(2) *Polentina di Cittadella.* The further uses of maize in northern Italy for human food are as follows:

(3) *Pane Giallo,* of Milan, a baked loaf made half of maize and half of wheat meal.

(4) *Pane Mistura,* of Milan and the Veronese, a baked loaf of varied shape made of one-third maize and two-thirds wheat meal.

(5) *Pane Mistura Con Uva* which is No. (4) mixed with rasins.

(6) *Foccacia,* (Fogassa, Verona city dialect; Pissotta or Pinze, Country, Veronese dialect). As I saw it made in a peasant's kitchen near Verona, it is produced as follows: Take one pint of yellow maize meal, mix it with two pints of wheat flour. Pour upon the mixture half a teacupful of melted butter; add then two tablespoonfuls of white sugar and one tablespoonful of soda; this done, pour on gradually about a half a pint of hot water and roll and knead the mass well. Finally having made the dough into a round ball, flatten it into a cake about ¾ of an inch thick and 10 inches in diameter, both sides of which are to be well stippled with the point of a knife. Fry it then in a pan greased with about a half a teacupful of butter and raised about two inches over a pile of live but flameless embers.

(7) *Cinquantino* (Zinquantin, dialect Veronese) as eaten near Padua and Verona. This is the young, milky ear of the white variety of maize roasted near the embers.

(8) *Melica Dolce.* A small sugared cake made of maize meal in Milan.

(9) *Pane d'Anelli,* eaten in the Milanese. A mixed bread baked of two-thirds maize and one-third wheat, recently invented by the Rev. Signor Anelli, of Monza, as a cheap substitute for Pane Mistura, and as a cure for Pelagra in districts where peasants who eat maize four or five times a day suffer from the disease.

The two well known and commonly used varieties of maize in northern Italy are the bianco (white) producing a white meal but considered of inferior flavor as polenta, and the rosso (red) with a very brilliant reddish-yellow tinge on the cob, and producing a golden yellow meal.

By the tenth of September the russet fields of the ripening grain are as characteristic of the Lombard plain, as the horizon obstructing locust hedges, or the pollard trees festooned with grape vines. But the ears ripen on clipped stalks and we miss the wigwam shaped stacks of American "fodder." I saw peasants threshing maize with flails near Verona, but could hear nothing of pounding the grain with pestle and

mortar. Hominy large or small and "ash" and "hoe" cakes seemed unknown, and the interesting Mexican edible products of maize like "tortillas," (wafer like cakes of baked maize dough,) or the peppered dumplings called "tomales" had no more place in the Lombard kitchen than the transatlantic art of crushing on metates the water soaked and softened grains. Near Castel Franco, I saw a large bunch of red ears hanging by their twisted husks on the wall of a roadside shrine.

An etymology has been suggested for the name Grano Turco, in the antics of boys when bearded and moustached with maize silk, they mimic the fierce looks of Turks in the high "corn." We cannot think that the Italian lad does not smoke the mock tobacco that must tempt him upon each ear. If he does he apes a habit no less American in its origin than the maize itself. So the American lad playing with a "shoe string bow" on a "corn-stalk fiddle" would turn to Italy for his inspiration.—H. C. MERCER.

MICROSCOPY.[1]

Cytological Methods.—*Lysol.*—Friedrich Reinke[2] calls attention to the antiseptic *lysol* (a solution of Cresol in neutral soap) as a valuable reagent for the nucleus. *It dissolves chromatin,* leaving other elements intact; and it brings out a new element in the nucleus, to which the author gives the name, *œdematin.* This substance appears in the form of granules within the linin mesh-work of the nucleus, remaining after the chromosomes have been completely dissolved. A small salamander larva, for example, left in about 50 ccm. of 10 per cent *lysol* for from 6 to 24 hours, will have its chromatin dissolved, and its œdematin granules rendered visible.

Œdematin shrinks greatly in such reagents as alcohol, chromic acid, and osmic acid, and only now and then appears as a *fine* granular precipitate. In lysol, on the contrary, it swells up under the action of one constituent (the soap solution) and is coagulated by the cresol and thus made distinct. Œdematin corresponds, in part at least, to Heidenhain's *oxychromatin,* Pfitzner's *parachromatin,* and Frank Schwarz's *paralinin.* Reinke remarks that this substance is absent, or nearly so, from ova and spermatozoa. It is well developed in most somatic cells: e. g., epithelium, connective tissue, leucocytes, etc.

In the action of lysol, three stages are to be distinguished: (1) solution of the chromatin; (2) appearance of œdematin granules; and (3) further changes of the œdematin.

The time required to reach the second stage varies with the tissue. The epithelium of the salamander larva requires at least six hours. In connective tissue the second stage is quite short and transitory.

The method does not admit of permanent preparations.

Neutral versus Acid Fixatives for Nuclei.[3]—Professor Altmann claims that the usual acid reagents, among which he reckons sublimate, platinum-chloride, gold-chloride, etc., disturb nuclear structure, reducing the chromatic elements to compact, structureless masses. On the other hand, *neutral* reagents, among which are placed osmic acid, and a mixture of chromic acid with a molybdenum salt, preserve the structure of nuclei. At first sight, and under low powers, nuclei present a homogeneous appearance. But this homogeneity is not

---

[1] Edited by C. O. Whitman, University of Chicago.

[2] Anat. Anz. VIII, Nos. 16 and 18, 1893, and Arch. f. m. Anat. XLIII, No. 3, 1894.

[3] Altmann. Verhandl. d. Anat. Ges. Mag., 1893, p. 50.

real; for structure is there and it can be made out, although with some difficulty. Cell nucleus and cell body, although chemically different, exhibit the same morphological structure, consisting of *granula* and *inter-granular net-work*. Altmann was able to demonstrate the granular structure of the chromosomes.

Heidenhain (Arch. f. mik. Anat., XLIII, 3, p. 428) maintains, in opposition to Altmann, that with sublimate the granula and net-work are demonstrable; and further, that acid reagents are, after all, superior to neutral reagents.

Iron-hæmatoxylin and Centrosomes.[4]—Iron-hæmatoxylin has been used by Heidenhain in the study of the centrosomes and astrospheres.

The original process, which is also repeated in the new modification, was the following:

Fine sections of preparations in sublimate are fixed on the slide by means of distilled water, dehydrated with alcohol containing iodine, and exposed to a 1½ per cent solution of ammonio-ferric alum.[5] The slide is next washed with distilled water and then placed in a 1½ per cent solution of *Hœmatoxylinum purissimum* (Grübler). The overstained sections are then again treated with the iron-alum solution used before, in order to remove the superfluous color. The process of extraction must be followed under the microscope and continued until the cell protoplasm is completely decolorized, and the chromatin network of the nucleus becomes clear. One may interrupt the differentiating process any moment by washing with fresh water, and then continue it. When the extraction of the stain has been carried far enough, the slide should be washed fifteen minutes in fresh water and mounted in the usual way in balsam.

Heidenhain noticed that when the differentiation was effected quickly the centrosomes were stained in greater number than when the process occupied a long time. It seemed, therefore, that the defects of the method might be corrected if a way could be found by which the decoloring process could be hastened. How could the cytoplasm be freed from the stain in the shortest time? Assuming that a stain acts by chemical combination, it seemed probable that the process of extraction might be hastened, if the receptivity of the cytoplasm could be at least partially saturated before the application of the hæmatoxylin. Accordingly, Heidenhain selected as *preliminary* stains

---

[4] Arch. f. m. Anat. Vol. XLIII, part 3, p. 434.

[5] The crystals of this salt should be clear violet in color; if they are yellowish and opaque, they have suffered from exposure to air and are no longer fit for use. The solution must be made cold, as the salt is decomposed by heat.

("Vorfarben") such as affect the cytoplasm and the nucleus, and leave the centrosomes unstained. Thus the chemical affinities of the centrosomes for the hæmatoxylin would remain at full strength, while those of the cytoplasm and nucleus would be more or less saturated, and to the same extent weakened for the hæmatoxylin. In this way the process of extraction was brought under some control, and the method greatly improved.

Stains reached in this way are called "subtractive."

Bordeau R., Anilin blue and Methyl-eosin were employed as preliminary stains. Bordeaux R. proved to be the best. In preparations that have been successfully differentiated as to the centrosomes, the nucleus and its chromatin are almost colorless, so that the centrosome may be easily studied, even when it lies behind the nucleus. The *nucleoli* remain strongly stained.

The Chromatin.—Heidenhain shows that there are two kinds of chromatin to be distinguished, namely: an *oxychromatin* brought out by *acid* anilin stains (e. g., Rubin S.), and a *basichromatin* which is brought out by *basic* anilin stains (e. g., Methyl green). The "basichromatin" is the chromatin of Flemming and authors in general.

The differentiation of the two chromatins can only be accomplished when the nucleus is exposed at the same time to both *acid* and *basic* anilin colors, as is the case when Biondi's solution and Ehrlich's triacid are used.

If one mixes ammonium vanadate with hæmatoxylinum pur (Grübler) a blue stain is obtained which stains *cytoplasm* and *oxychromatin* strongly, while the *basichromatin* is often left nearly colorless.

The two chromatins probably differ only in the amount of phosphorus present, basichromatin containing more, oxychromatin less.

The Egg-Centrosome.[6]—Dr. H. Mertens finds that the so-called "yolk-nuclei," so generally known in both vertebrate and invertebrate eggs, represent, in the case of the mammals and birds, two very different elements. Sometimes they are chromatin granules eliminated from the nucleus; at other times they represent centrosomes. The identification of these bodies with the centrosome is the point of chief interest. The method employed was as follows: The material was prepared in Hermann's fluid. Three precautions were observed: (1) The object must remain a long time in the fluid—for weeks or even months. (2) Transfer to pyroligneous acid (1–3 ds.). (3) Wash thoroughly in running water.

The preparations were imbedded in celloidin and stained with safranine.

[6] H. Mertens, Arch. de Biologie, XIII, 3, '94, p. 394.

SCIENTIFIC NEWS.

Dr. Carl Röse, so well known for his investigations on the structure and development of the teeth, has issued, in connection with Dr. A. Gysi, of Zürich, a set of twelve microphotographs of the histology of the teeth. The photographs are 18 cm. square, and are sold at 12 marks ($3.00) the set. Dr. Röse's address is Friedrichstrasse, 12, Freiburg i B, Germany.

Professor Lamson Scribner had his entire herbarium which was especially rich in grasses, stored in the Knox warehouse which was burned in August. The entire collection except the genus Panicum was destroyed.

Mr. T. H. Kearney, Jr., has been appointed Curator in the Columbia College New York Herbarium.

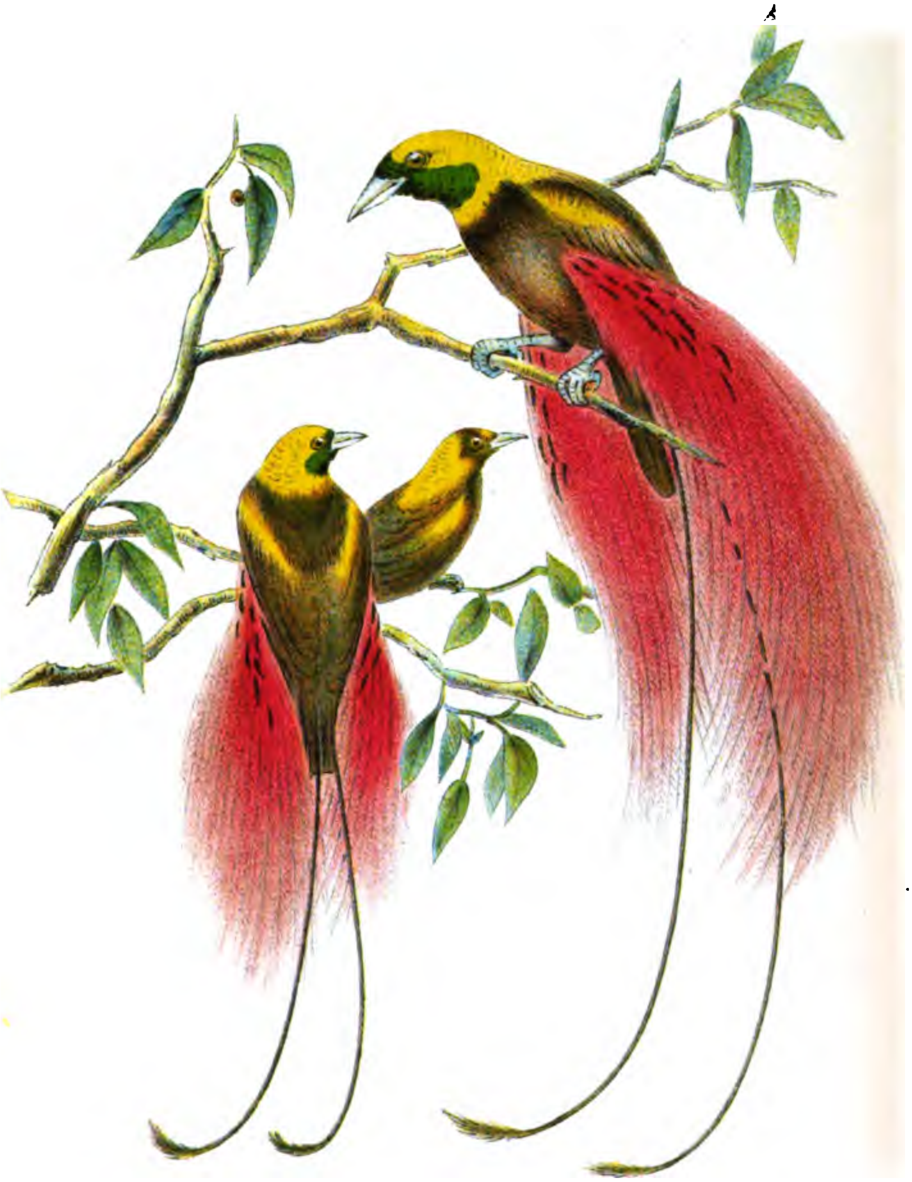
Dr. Harrison Allen has resigned the directorship of the Wistar Institute of Anatomy in Philadelphia, and Dr. Horace Jayne has taken his place.

Prof. Chas. T. Prosser has left Washburn College Topeka Kansas, and has taken a position at Union College Schenectady, New York.

The Academy of Sciences of San Francisco has published an illustrated volume of Proceedings consisting largely of important contributions to the zoology of Lower California.

Errata.—In the Article "Abalone or Haliotis Shells of the Californian Coast," on page 858, ninth line from top, "As these strips of solid silver," should read "As thin strips of solid silver."

PLATE XXXI.



PARADISEA RAGGIANA

(From Gould's Birds of New Guinea)

THE

AMERICAN NATURALIST

VOL. XXVIII. December, 1894. 336

QUATERNARY TIME DIVISIBLE IN THREE PERIODS, THE LAFAYETTE, GLACIAL, AND RECENT.[1]

BY WARREN UPHAM.

According to definitions in text-books by Dana, Archibald Geikie and Etheridge, the Quaternary era began with the change from the mild Pliocene climate to that of the Glacial period, with its accumulation of the vast sheets of land ice in high latitudes, and has continued to the present time. We are living in the Quaternary era, as thus defined, and it must extend far into the future to be at all proportionate in length with the previous co-ordinate divisions of geologic time. Le Conte and Prestwich, however, consider the Quaternary division of time as completed at the dawn of civilization, with traditional and written history; and they assign recent geologic changes to a new era, named by Le Conte the Psychozoic, which is separated from the preceding principally on account of the supremacy of man. The former view seems preferable, because man is known to have been contemporaneous with the Ice age.

Quaternary time, therefore, is here assumed to include (1) the period of changed conditions causing the accumulation of

---

[1] Presented before Section E of the American Association for the Advancement of Science at the Brooklyn meeting, August 20, 1894; also partly contained in a paper read before the Geological Society of America, August 16, 1893, as published in its Bulletin, Vol. V, pp. 87-100, January, 1894.

the ice-sheets; (2) the Glacial period, when the glacial and modified drift were formed; and (3) the Postglacial, Recent, or Present period, extending from the departure of the ice-sheet until now. The first and second of these periods, which were comparatively long, constitute the Pleistocene division, while the third and very brief period is the Present or Psychozoic division, of the Quaternary era.

THE LAFAYETTE PERIOD.

The broad lower part of the Mississippi Valley, from the southern boundary of the glacial drift to Louisiana, contains a very extensive unfossiliferous deposit of sand and gravel, designated formerly from its prevailing ferruginous color as the Orange sand, later called by McGee the Appomattox formation in its development on the costal plain of the Atlantic and Gulf States, but recently named the Lafayette formation, from Lafayette County in northern Mississippi, where it was earliest discriminated by Professor E. W. Hilgard in 1855 and 1856. This formation was spread across the valley plain 50 to 150 miles or more in width along an extent of 600 miles from the mouths of the Missouri and Ohio Rivers to the Gulf of Mexico, during the closing stage of the Tertiary era and the beginning of the Quâternary, to each of which it has been assigned. McGee,[2] Chamberlin[3] and Salisbury,[4] hold that it is probably referable to the Pliocene period; while Spencer,[5] Hilgard,[6] E. A. Smith[7] and others, as it seems to me preferably, have considered it as the earliest of our Pleistocene formations. Its northern continuation beneath the glacial drift is recognized by Salisbury[8] in western Illinois to a distance of a hun-

[2] Am. Journ. of Science, III, Vol. xxxv, February, April, May and June, 1888; Vol. xl, July, 1890. U. S. Geol. Survey, Twelfth An. Rep., for 1890–91, pp. 347–521, with 10 plates, and 45 figures in the text.

[3] Bulletin Geol. Soc. of America, Vol. i, 1890, pp. 469–480. Am. Jour. Sci., III, Vol. xli, May, 1891.

[4] Article last cited. Geol. Survey of Arkansas, An. Rep. for 1889 (published 1891). Vol. ii, "The Geology of Crowley's Ridge," pp. 224–248.

[5] Geol. Survey of Georgia, First An. Rept., for 1890–91, p. 62.

[6] Am. Jour. Sci, II, Vol. xlii, May, 1866; Vol. xlvii, Jan., 1869; Vol. xlviii, Nov. 1869; III, Vol. ii, Dec., 1871; Vol. xliii, May, 1892. Am. Geologist, Vol. viii, Aug., 1891, pp. 129–131.

[7] Am. Jour. Sci., III, Vol. xlvii, April, 1894.

[8] Bulletin Geol. Society of America, Vol. iii, 1892, pp. 183–186.

dred miles northward from the Missouri River and boundary of the drift, and gravels believed by him to be probably of the same formation occur in the Wisconsin and Minnesota driftless area, while northeastward he has observed the Lafayette gravels in the Ohio Valley in southern Indiana about 150 miles from the Mississippi. McGee states that the Lafayette beds attain their maximum thickness, which is 200 feet or more, in the region about the mouth of the Mississippi, and that they vary thence to a thin veneer, the thickness being proportional directly with the volume of neighboring rivers and inversely with the extension inland.

Previous to the maximum advance of the ice-sheet, the Mississippi River and all its large tributaries eroded deep and broad valleys through the Lafayette formation and underlying strata, cutting at New Orleans to a depth at least 760 feet below the present sea level. Along the central valley, from Cairo to the Gulf, this erosion averages probably 200 feet in depth upon a belt 500 miles long, with a width of 50 to 100 miles, excepting isolated plateau remnants of the Lafayette and older beds, of which the largest are Crowley's and Bloomfield ridges, in Arkansas and Missouri. The land during the valley erosion was certainly 760 feet higher than now, but this I think to be only a small fraction of its uplift. From the transportation of northern Archæan pebbles and cobbles of crystalline rocks to the Lafayette beds of the lower Mississippi and of Petite Anse Island, on the Gulf shore, in the direct line of the axis of the Mississippi Valley, Hilgard believes that during the deposition of these beds the valley had a greater descent and stronger currents of its river floods. He suggests that the increased altitude of the interior of the continent needed to give these formerly more powerful currents may have been 4000 to 5000 feet, being sufficient, probably, to bring the cold climate and ice accumulation of the Glacial period.

Marine submergence of the low coastal and Mississippi Valley areas occupied by the Lafayette formation is supposed by McGee and Spencer to have been requisite for the deposition of its sand and gravel beds, but they see that immediately

afterward the land was much higher than now, to permit the extensive and deep erosion of that time. A simpler view of the epeirogenic movements, closing the Tertiary era and inaugurating the Quaternary, seems to me to be found in ascribing these beds to deposition on land areas by flooded rivers descending from the Appalachian mountain region and from the Mississippi basin, spreading gravel, sand and loam over the coastal plain and along the great valley during the early part of a time of continental elevation. The land had lain during the long Tertiary periods at lower altitudes, and its surface was largely enveloped by residual clays and by alluvial sand and gravel. With the elevation of the continent, increased rainfall and snowfall and resulting river floods swept away these superficial materials from the higher lands and spread them on the coastal plain and along the Mississippi Valley, where the streams expanded over broad areas with shallow and slackened currents. As the elevation increased, however, the rivers would attain steeper slopes and finally erode much of the deposits which they had previously made. During the culmination of the uplift, which the writer believes to have been the chief cause of the Ice age, Chesapeake and Delaware Bays were excavated and erosion was in progress at a far more rapid rate than with the present low altitude of this region.

The Lafayette formation seems to me more closely related to the Glacial period and the conditions producing the ice-sheets than to the preceding very long Tertiary era, and for the same reasons which have been well stated by Hilgard and Spencer, namely, their dependence alike on the epeirogenic elevation.[9] With the Ice age we should unite this probably

---

[9] That epeirogenic movements of land elevation caused the accumulation of the Pleistocene ice-sheets, and conversely, that the end of the Glacial period was due to land depression, I have shown in an appendix of Wright's "Ice Age in North America," 1889, pp. 573–595; the Am. Geologist, Vol. vi, pp. 327–339, Dec., 1890; and the Am. Journal of Science, III, Vol. xli, pp. 33-52, Jan., 1891; and same, Vol. xlvi, pp. 114-121, Aug., 1893. This view, which may be called the epeirogenic theory of the causes of the Ice age, has been gradually thought out in America by Dana, LeConte, Hilgard, Wright and others, and in Scotland by Jamieson. Its earliest announcement was in 1855, by Dana in his Presidential Address before this Association (Proc. A. A. A. S., Vol. ix, for 1855, pp. 28, 29; Am. Jour. Sci., II, Vol. xxii, pp. 328, 329, Nov., 1856).

much longer preglacial time of gradual uplift of the continent, and the Postglacial or Recent period in which we live, to form together the three successive parts of the Quaternary era. How long the early part comprising the epeirogenic uplift, represented by the deposition and erosion of the Lafayette formation, may have been, we can only vaguely or perhaps approximately estimate. During the beginning of the uplift its effect would be probably to increase the transportation and deposition of gravel and sand by the rivers many times beyond their present action. The rate of average land erosion now prevailing throughout the drainage area of the Mississippi is supposed by McGee to be competent to supply in about 120,000 years a volume of river gravel, sand, and silt equal to the original Lafayette formation in the Mississippi Valley. With the greater altitude and increasing slopes of the land during the deposition of the Lafayette beds it may have required a third or a sixth of the time here mentioned, that is, some 40,000 or 20,000 years. As the elevation continued, however, rapid fluvial erosion of these deposits and of the underlying strata ensued, which was extended over so long and broad an area of the lower Mississippi Valley, and to such depth, that, even with the high continental elevation of 2000 to 3000 feet, known from submerged valleys off both the Atlantic and Pacific coasts, it must have required a long epoch. Perhaps it may be reasonably estimated twice as long as the time of the deposition, or somewhere between 40,000 and 80,000 years. The Lafayette period thus comprised two parts or epochs, the first characterized by deposition of the formation, the second by its extensive erosion and the culmination of the continental uplift.

THE GLACIAL PERIOD.

Comparison of the work of the glaciers and ice-sheets of the present time with those of Pleistocene time seems to me best accordant with a reference of all our glacial drift to a single continuous period of glaciation, which, though occupying probably 20,000 years or more, was yet brief as compared with the duration of most other recognized geologic periods or

epochs. The outflow of the upper part of the Pleistocene ice-sheets probably exceeded the currents of narrow alpine glaciers, but was less than the advance of broad and deep polar glaciers which end in the sea. For the journey of Pleistocene boulders 1000 miles in the ice-sheet, somewhat less than 3000 years would be required if the average of the glacial currents was five feet per day. The amount of the glacial erosion and of the drift, when compared with the erosion by the Muir glacier in Alaska, imply a short rather than a long duration of the Ice age. This conclusion is further affirmed by the continuance of the same species of the marine molluscan faunas from the beginning of the Glacial period to its end and to the present day.

The duration of the Ice age, if there was only one epoch of glaciation, with moderate temporary retreats and readvances of the ice-borders sufficient to allow stratified beds with the remains of animals and plants to be intercalated between accumulations of till, may have comprised only a few tens of thousands of years. On this point Prestwich has well written as follows: "For the reasons before given, I think it possible that the Glacial epoch—that is to say, the epoch of extreme cold—may not have lasted longer than from 15,000 to 25,000 years, and I would for the same reasons limit the time of . . . . the melting away of the ice-sheet to from 8000 to 10,000 years or less."[10]

Very gentle currents of broad river floods in the Missouri and Mississippi Valleys deposited the North American loess, attending the maximum extension of the ice-sheet and accompanying its departure up to the time of formation of the great marginal moraines. The loess thus testifies that previous to the farthest glacial advance the land sank to its present altitude, and probably somewhat lower on the area of the early drift, but not to the sea level. The vast weight of the continental glacier seems to have been the chief or only cause of this subsidence, as was first pointed out by Jamieson for the similar depression of the British Isles and Scandinavia at

---

[10] Quart. Jour. Geol. Soc., London, Vol. xliii, 1887, pp. 407, 408. Geology Vol. ii, 1888, p. 534.

the time of final melting of the European ice-sheet. The explanation of this continuance of the ice accumulation and advance after the depression of the land began and until the maxima, both of the land subsidence and ice extension, were attained, with a low altitude and even less descent of the lower Mississippi than now, has been well given by LeConte.[11] The subsidence was doubtless slow, even though probably many times faster than the preceding uplift. It may have occupied only 5000 years, being at a yearly rate of a half a foot to one foot; but possibly it was two or three times as long. While the slow sinking of the land was taking place, the accumulation of the ice by snowfall may have proceeded at a somewhat more rapid rate, so that the thickness of the ice-sheet and the altitude of its surface were increasing up to a maximum nearly coincident with that of the subsidence. Finally, however, the subsidence brought a warmer climate on the southern border of the ice, causing it to retreat, and giving to it in the region of the marginal moraines a mainly steeper frontal gradient and more vigorous currents than during its growth and culmination.

The time of general retreat of the ice-sheet in North America, with low altitude of the land and marine submergence of the coastal borders of northeastern New England, northward from Boston, and of the eastern provinces of Canada, with ingress of the sea along the valleys of the St. Lawrence and Ottawa Rivers and the basin of Lake Champlain, has been named by Dana the Champlain epoch. It was the final stage of the Glacial period, and was characterized by the rapid deposition of the glacial and modified drift, whose materials had been contained in the lower part of the ice-sheet.

THE POSTGLACIAL, RECENT, OR PRESENT PERIOD.

Closely following the deposition of the modified drift as wide and deep flood-plains in the principal river valleys draining away from the departing ice, these beds were deeply eroded by the streams as soon as the ice-front had so far

---

[11] Bulletin Geol. Soc. of America, Vol. ii, 1891, pp. 329, 330. Elements of Geology, third edition, 1891, p. 589.

receded that the supplies of water and drift from its melting ceased. Much of the valley drift was soon removed by the river channelling, and its remnants, being left as terraces on the sides of the valleys, caused this first stage of the Postglacial period to be long ago named by Dana the Terrace epoch. In less vigorous action the streams have continued at the same work to the present day, so that this term may be extended also to comprise this whole period.

In various localities we are able to measure the present rate of erosion of gorges below waterfalls, and the length of the postglacial gorge divided by the rate of recession of the falls gives approximately the time since the Ice age. Such measurements of the gorge and falls of St. Anthony by Professor N. H. Winchell, show the length of the Postglacial or Recent period in Minnesota to have been about 8000 years; and from the surveys of Niagara Falls, Mr. G. K. Gilbert estimated it to have been 7000 years, more or less. From the rates of wave-cutting along the sides of Lake Michigan and the consequent accumulation of sand around the south end of the lake, Dr. E. Andrews believes that the land there became uncovered from its ice-sheet not more than 7,500 years ago. Professor G. Frederick Wright obtains a similar result from the rate of filling of kettle-holes among the gravel knolls and ridges called kames and eskers, and likewise from the erosion of valleys by streams tributary to Lake Erie; and Professor Ben. K. Emerson, from the rate of deposition of modified drift in the Connecticut Valley at Northampton, Mass., thinks that the time since the Glacial period cannot exceed 10,000 years. An equally small estimate is also indicated by the studies of Gilbert and Russell for the time since the last great rise of the Pleistocene lakes, Bonneville and Lahontan, lying in Utah and Nevada, within the arid Great Basin of interior drainage, which are believed to have been contemporaneous with the great extension of ice-sheets upon the northern part of the North American continent.

Professor James Geikie maintains that the use of paleolithic implements had ceased, and that early man in Europe made neolithic (polished) implements, before the recession of the

ice-sheet from Scotland, Denmark and the Scandinavian peninsula; and Prestwich suggests that the dawn of civilization in Egypt, China and India may have been coeval with the glaciation of northwestern Europe. In Wales and Yorkshire the amount of denudation of limestone rocks on which drift boulders lie has been regarded by Mr. D. Mackintosh as proof that a period of not more than 6000 years has elapsed since the boulders were left in their positions. The vertical extent of this denudation, averaging about six inches, is nearly the same with that observed in the southwest part of the Province of Quebec by Sir William Logan and Dr. Robert Bell, where veins of quartz marked with glacial striæ stand out to various heights not exceeding one foot above the weathered surface of the enclosing limestone.

From this wide range of concurrent but independent testimonies, we may accept it as practically demonstrated that the ice-sheets disappeared only 6000 to 10,000 years ago. Within this period are to be comprised the successive stages of man's development of the arts, from the time when his best implements were made of polished stone through the ages of bronze, iron, and finally steel, to the present time when steel, steam and electricity seem to bring all nations into close alliance.

ESTIMATED DURATION OF THE QUATERNARY ERA.

Arranged in chronologic order, we have derived for the three parts of the Quaternary era, as here defined, the following estimates of their duration: the Lafayette period or time of preglacial epeirogenic elevation, with the deposition and erosion of the Lafayette beds, some 60,000 to 120,000 years; the Glacial period, regarded as continuous, without interglacial epochs, attending the culmination of the uplift, but terminating after the subsidence of the glaciated region, 20,000 to 30,000 years; and the Postglacial or Recent period, extending to the present time, 6000 to 10,000 years. In total, the Quaternary era in North America, therefore, has comprised probably about 100,000 or 150,000 years, its latest third or fourth part being the Ice age and subsequent time. The Tertiary era appears by the changes of its molluscan faunas to have been

vastly longer, having comprised, perhaps, between two and four million years, of which the Pliocene period would be a sixth or eighth part, thus exceeding the whole of the ensuing era of great epeirogenic movements and resulting glaciation.

DIVISIONS OF QUATERNARY TIME.

The following table of the several divisions, periods and epochs of Quaternary time, as reviewed in this paper, is arranged in the descending stratigraphic order of their geologic formations.

Psychozoic division	Recent period	Recent or Present epoch.
		Terrace epoch.
Pleistocene division	Glacial period	Champlain epoch.
		Glacial epoch.
	Lafayette period	Epoch of great elevation and erosion.
		Lafayette epoch.

THE HOMOLOGIES OF THE UREDINEAE (THE RUSTS).

BY CHARLES E. BESSEY.

The place of the parasitic plants constituting the Order *Uredineae* (The Rusts), in a natural system of classification, has long been in doubt, botanists not being fully agreed as to the homologies existing between these and other fungi. In a study of this group, extending over many years, I have been led to a view of the homologies between these plants and the Ascomyceteae and Basidiomyceteae, somewhat at variance with the theories of most recent writers; and it is probable that the time has come for a more definite statement of this view than has yet been given.

GENERAL STRUCTURE.

The *Uredineae* are parasitic within the tissues of higher plants, for the most part Anthophyta. They consist of septated branching threads which vegetate for some time within the host, and eventually produce spores (*conidia*) in chains, by abstriction. These spores develop upon numerous, crowded, parallel, terminal branches, within the tissues of the host, at length bursting through the epidermis. The outer conidial branches are modified into a "peridium," which surrounds the erumpent spore-mass like a tiny cup, whence the common name, "Cluster-cup," in allusion also to the fact that the spore-cups usually appear upon the leaf in clusters. For a long time these cluster-cups were supposed to have no connection with the rusts, and they accordingly were described under the generic names *Aecidium* and *Roestelia*. The first of these names is preserved in the term "aecidiospore," by which the spores are often designated. (Figs. I and II of Plate XXXII.)

Somewhat later, spores of another kind are produced singly upon the ends of other branches in the tissues of the host. These, while occurring in clusters, are by no means as closely

and regularly crowded as the aecidiospores, so that when they burst through the epidermis of the host they constitute elongated or irregular shaped spore-dots (*sori*) instead of definitely outlined cups. Here again, the spores of this kind were regarded by the earlier botanists as belonging to a distinct genus, *Uredo*: hence we commonly still speak of them as *uredospores*. They are also known as "stylospores," in allusion to the fact that they are stalked. (Figs. III and IV of Plate XXXII.)

Still later, a third kind of spore is produced, often in the uredosori, which bear some resemblance to the uredospores in being stalked, and in some cases, one-celled (*Uromyces*, *Melampsora*), but differing often in being two or more celled, and usually having a thicker wall. These are the last to develop upon the mycelium within the host, and when they have ripened, usually the parasite dies. Since these spores appear to complete the development of the parasite, they have long been known as teleutospores (τελευτή, "completion.") They germinate (in many species after a period of rest through the winter months) by the production of a short, several-jointed filament (the *promycelium*), from each cell of which short lateral branches develop, upon whose summits single minute spores (sporidia) are formed by abstriction. When these sporidia germinate upon the proper host they form parasitic threads which penetrate its tissues and give rise to the aecidia described above, thus completing the cycle of life. (Figs. V to XIII of Plate XXXII.)

The life history here sketched may be taken as typical, but it is subject to several modifications, e.g., (*a*) the omission of the aecidial stage; (*b*) the omission of the uredo stage; (*c*) the omission of both the aecidial and the uredo stages. Moreover, in many species the aecidial stage occurs upon a different host from that which supports the uredo and teleutospore stages, this condition being known as heteroecism, a familiar example of which may be seen in one of the common rusts of wheat (*Puccinia graminis*), where the aecidiospores develop on the leaves of the Barberry (*Berberis vulgaris*), the uredospores and teleutospores alone occurring in the leaves and stems of

the wheat. In many heteroecismal species it has hitherto been found impossible to determine the aecidium belonging to it, and for many aecidia occurring upon common plants, the uredo and teleutospore stages are not known. The difficulties surrounding this problem are so great as to discourage the attempt to solve them.

HOMOLOGY OF PARTS.

Having now a general idea of the structure of the *Uredineae*, we come to the important question of the homology of their parts. Here, again, we are beset with difficulties. No sexual organs have yet been discovered, and there has been very much structural degeneration of the whole plant.

In their general structure the Uredineae show clearly that their relationship is with the *Ascomyceteae* or *Basidiomyceteae* rather than with the *Phycomyceteae*, and upon this point there has been little disagreement among recent botanists. Some authors regard the aecidium as a kind of degenerated apothecium, in which each conidial chain is a modified ascus. In this view, the aecidium is the result of an obsolete or obsolescent sexual act, as in the *Discomyceteae*, and the uredospores and teleutospores are considered to be conidial structures. Accordingly, those who hold this view quite consistently set off the *Uredineae* in a class bearing the name *Aecidiomycetes*. By far the greater number of botanists, however, now regard the teleutospores as basidia, homologous with the basidia of the *Hymenomyceteae* and *Gasteromyceteae*, and they therefore place the *Uredineae* in the class *Basidiomyceteae*. In this view, the sporidia which develop upon the germination of the teleutospore are basidiospores, homologous with those of mushrooms and puff balls, and the uredospores and aecidiospores are forms of conidia. It is needless in this paper to set forth these views at length, since they may be found in almost any common text-book of botany.

Briefly stated, the view which I wish to present is that the "teleutospore," so-called, is a tightly fitting ascus, containing one or more large spores; the teleutosorus is a reduced apothecium; the aecidiospores are the normal conidia; and the

uredospores secondary or accessory conidia (stylospores). In many cases the ascus-wall is readily separable from the contained spore or spores; but for the most part, the ascus-wall is so closely adherent as not to be distinguished from the spore-wall without treatment by potassic hydrate or other reagents.

In one genus, *Uropyxis,* the ascus is much larger than the double spore it contains, and may be observed very easily without special preparation. (Fig. VIII of Plate XXXII.) In *Gymnosporangium* in fresh material an ascus cavity considerably larger than the double spore can be seen in carefully made preparations. Young "teleutospores" of *Phragmidium,* in which the spores have not yet attained full size, show the ascus-wall very clearly, (Fig. IX of Plate XXXII), although in mature specimens by the enlargement of the spores it can be seen with difficulty, if at all. By careful examination, one may make out the ascus-wall in a good many cases where otherwise it might be overlooked. I have little difficulty in distinguishing it in some species of *Uromyces* (where the ascus contains but one spore) and *Puccinia* (where the ascus contains one double spore, or more accurately speaking, two spores), especially after the application of strong potassic hydrate.

THE QUESTION OF RELATIONSHIP.

The view here set forth, that the so-called "teleutospore" is an ascus with its contained spore or spores, involves the supposition that the *Uredineae* have suffered much structural degeneration. When we consider the fact that they are, as we may say, *intensely* parasitic, there is no improbability that we are dealing here with a greatly reduced plant structure. One has but to contrast a Dodder with a Morning Glory, or a Broom-Rape (*Aphyllon*) with a Figwort (*Scrophulariaceae*) in order to realize what great changes are produced by a parasitic habit. It has long been well known in biology that the greater the parasitism of an organism the greater is its degeneration. Some plants take but little from their hosts, and still maintain their roots, stems and leaves with so little change

that it is scarcely perceptible. It is said that some of the Gerardias are parasitic, and yet who can perceive in the countenance of any of our species any evidence of this particular vegetable sin? The closely related painted cups (*Castilleia*), however, give evidence in their appearance that their habits are not what they should be. It is even more so with *Comandra*, while the Mistletoe bears the marks of degradation upon every organ. It is not otherwise with the Carpophytes. When some ancestral seaweeds became saprophytic and parasitic, that structural degeneration of parts began which gave us the many kinds of fungi. No one may now trace with certainty the genetic line of the fungi, but that they originated from holophytic ancestors cannot be doubted; nor can there be reasonable doubt that they have become structurally more and more modified the further they have departed from holophytic habits. The holophyte requires masses of chlorophyll-bearing cells, or as we commonly express it, its vegetative organs must be well developed, but the hysterophyte has no use for such tissue, and consequently, its vegetative organs are undeveloped. The more perfectly the parasite adapts itself to its host the greater may be its departure from the structure of its vegetative organs which its holophytic ancestors developed. In like manner, the more perfectly the parasite merges itself into its host, and in a sense becomes a part of it, the more may it use the host tissues for protection and support, and the less is it necessary for it to develop protective tissues of its own. Thus we have in the fungi not only a degeneration of the vegetative tissues, but the reproductive organs have likewise undergone much degenerative modification.

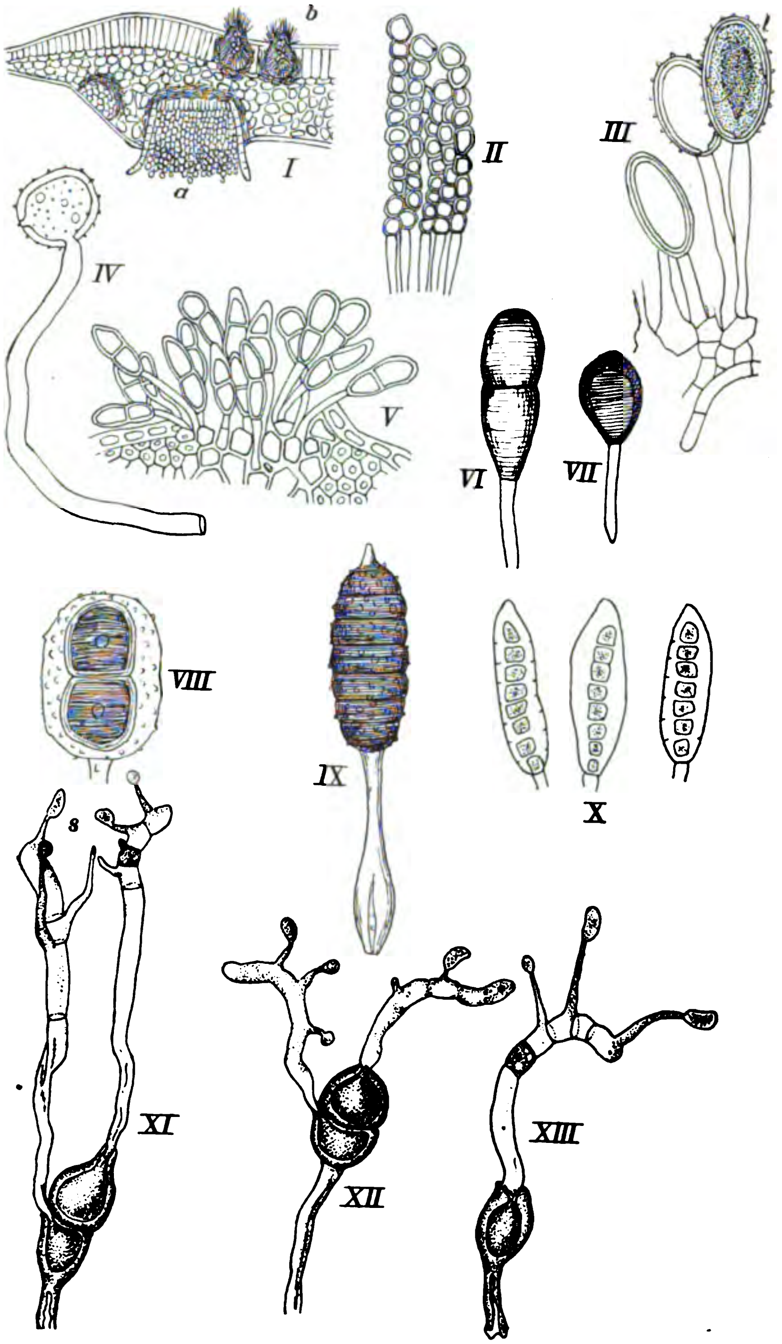
We here regard the *Uredineae* as degenerated Cup-Fungi (*Discomyceteae*), with their cups (apothecia) obsolescent, and constituting the vaguely defined teleutosori. As suggested above, there is here no need of that abundant accessory tissue which in the Cup-Fungi forms a protective envelope (exciple) around the hymenial mass, since the asci ("teleutospores") develop beneath the protecting epidermis of the host. The host-tissues in the case of the *Uredineae*, act the part of the exciple in the normal cup-fungi. The apothecia of the cup-

fungi are therefore homologous with the "sori" of the teleutospore stage of the *Uredineae*. Instead of the large eight spored asci, which are so common in the *Discomyceteae*, we find in the *Uredineae* that they are much reduced, both in size and the number of spores which they contain, there being rarely more than one or two. And here we may propose, in the light of the view here adopted, that the term "teleutospore," while a misnomer as usually applied, be retained with a restricted application to the spore or spores within the ascus. Thus we may say that the ascus of *Uromyces* contains but one teleutospore, while in *Phragmidium* it contains several. If necessary (which I doubt) to distinguish these reduced asci from normal ones, we may employ the convenient term ***teleutoasci***. We may thus have ***teleutosorus***, ***teleutoascus*** and ***teleutospore***.

PLACE IN THE SYSTEM OF PLANTS.

It remains to say a few words as to the place in the system of plants to be assigned to the *Uredineae* in accordance with these views. From what has been said, it follows that they are to be regarded as *Ascomyceteae*, instead of *Basidiomyceteae*, as so many recent botanists assert. Further, it is held that they are degraded and much modified forms standing at or near the end of a long genetic line, and not primitive or ancestral forms from which higher and more complex ones have sprung. The cup-fungi have not been derived from the *Uredineae*, but rather we may say that, in all probability, the latter have been derived by degeneration from the former. We must, therefore, assign the *Uredineae* to a place in the *Ascomyceteae*, *after* the *Dicomyceteae*. All may well agree to assign the *Perisporiaceae* to the first (or lowest) place in the class on account of their slight modification from the type of the holophytic Carpophytes. From this primitive group we pass easily along three somewhat divergent genetic lines, viz.: the *Tuberoideae*, *Pyrenomyceteae*, and *Discomyceteae*, and from the latter have sprung the *Uredineae*. The arrangement will then be as follows:

PLATE XXXII.



Uredineæ.

CLASS ASCOMYCETEAE.

Order *Perisporiaceae*,
Order *Tuberoideae*,
Order *Pyrenomyceteae*,
Order *Discomyceteae*,
Order *Uredineae*,
Order *Ustilagineae*.

CLASS BASIDIOMYCETEAE.

Order *Gasteromyceteae*,
Order *Hymenomyceteae*.

Of the relationship of the *Uredineae* to the *Ustilagineae* I need say no more at the present time than that the latter are here regarded as still further degradations of the *Discomyceteae*; nor is this the place in which to take up a discussion of the homologies between the *Ascomyceteae* and the *Basidiomyceteae*. Upon the latter point it is sufficient to say that the ascus and the basidium are regarded as morphologically equivalent, the ascus subdiving its protoplasmic contents into spores by an internal division (forming ascospores) while the basidium accomplishes the same thing by the growth of protrusions ("sterigmata") into whose enlarged ends the protoplasm passes, after which they separate as spores (basidiospores).

EXPLANATION OF PLATE XXXII.

I. Cross section of a Barberry leaf; *a*, a cup of aecidiospores; *b*, spermogones of *Puccinia graminis*, after Luerssen × 40.
II. Rows of aecidiospores (conidia) of *P. graminis* upon their conidiophores, after De Bary × 150.
III. Uredospores of *P. graminis*, the shaded one ripe, after De Bary, × 390.
IV. Germinating uredospore of *P. straminis*, after De Bary, × 390.
V. Cross section of a teleutosorus of *P. graminis*, after De Bary, × 200.

VI. Teleutoascus of *P. graminis*, external view, after Ludwig, × 450.

VII. Teleutoascus of *Uromyces fabae*, optical section, after Ludwig, × 450.

VIII. Teleutoascus of *Uropyxis amorphæ*, optical section, after Ludwig, × 450.

IX. Teleutoascus of *Phragmidium subcorticium*, external view, after Ludwig, × 450.

X. Immature teleutoasci of *Phragmidium subcorticium*, after Bessey, × 400.

XI. Germinating teleutospores (still within the ascus) of *Puccinia graminis; s.* sporidia, after Tulasne, × 400.

XII. Germinating teleutospores (still within the ascus) of *Puccinia moliniae*, after Tulasne, × 400.

XIII. Germinating teleutospore (within its ascus) of *Uromyces appendiculatus*, after Tulasne, × 400.

ON THE EVOLUTION OF THE ART OF WORKING IN STONE. A PRELIMINARY PAPER BY J. D. McGUIRE.

A REPLY BY CHARLES H. READ.

In the *American Anthropologist* for July, 1893, appeared an essay with the above title. The writer, with whom I am personally unacquainted, was good enough to send me a separate copy of it. I read it with some interest, for the efforts of an earnest worker, who attempts, by novel methods, to solve a difficult problem, cannot fail to be of interest to any one who has given attention to the problem itself.

The question of palæolithic man in America has, moreover, given rise to such fierce discussion that it seemed necessary to point out the danger that lies in the use of improper or irrelevant evidence. Such methods can only serve to mislead enquirers and to delay the solution of the puzzle. The paper now in question is so persistent in its pursuit of will-o'-the-wisps that a better text could scarcely be found.

The problem Mr. McGuire has set himself to resolve, stripped of all redundant matter, is this: whether the so-called palæolithic remains of Europe are necessarily older than the so-called neolithic? Incidentally he implies that "from a purely archæological standpoint, the paleoliths of Europe and the similar American implements are in all particulars, identical, and are productions of man existing under like conditions." What he understands by an archæological standpoint we shall see later, but first I would deal with the main contention.

Noscitur a socii is an axiom of archæology. When an object is found in the earth, and is dumb as to its own history, we naturally and justly turn to its companions to help us. This is good so far as it goes, and in an isolated case we may go wrong. But when we multiply the single case with fifty or a hundred, finding in all the same association of objects, and the circumstances attested by persons of known observation and probity, what before was probability is turned into as

great certainty as humanity can attain over the past. This, in a few words, is the foundation upon which paleolithic man in Europe now stands. This foundation might be broadened by much geological addition, but the argument would be none the more forcible. To put it more directly, certain flint implements are found in a stratum of a known age, so that this particular stratum comes to be recognized by all observers as their habitat. They are found elsewhere, truly, but when so found they usually bear indications of the vicissitudes they have undergone since leaving their home. Such flint implements, further, are found associated with the remains of animals which are universally admitted to belong to a given geological epoch. Here again they are so associated with such persistency, noted by such widely separated and independent observers, that the possibility of universal error is as wildly improbable as that of universal conspiracy. Such being the class of evidence upon which the antiquity of palæolithic man is founded, it is obvious that any attack, to be effectual, must be made on the premises. If it could be shown either that the palæolithic implements were not found in their undisturbed bed, or that the animal remains near them had no connection with them, then any conclusions based upon such association would necessarily fall to the ground.

Mr. McGuire takes, however, an entirely different stand. His theories are based upon his own experience as an amateur maker of stone implements, and his experiments have led him to the belief that it is *far easier* to make a polished stone implement than a chipped one, and that *therefore* polished *flint* implements are at least as old as those that are only chipped and not polished!

Has Mr. McGuire ever seen a specimen of Kafir or Polynesian carpentry? In the British Museum is a Kafir copy of a common European chair, made in the usual fashion as to shape, with slender spars for a back, a solid seat and spidery legs. This is cut from one solid block of wood, surely a far more difficult task than to make the chair by joining in the usual manner. Applying Mr. McGuire's argument to this case, and it does not seem an unfair application, for both the

Kafir and the Polynesian cuts everything from the solid, where does it land us? Are we to think that they began with joining, without doubt the easier method, and finally came to the more difficult, the cutting from the solid? Surely not; the natural explanation is the best, simply that the easier method of work did not occur to them.

From another point of view Mr. McGuire's experience is somewhat at variance with that of others. Palæolithic implements in Europe, and I would prefer to speak of Europe only at present, are made of very few materials, chiefly flint and quartzite. Mr. McGuire knows and admits this fact, but seems to assert that it is easier to form an implement by battering than by chipping. If the implement is to be of flint, I greatly doubt it, but if of certain stones of difficult or uncertain fracture, it may well be the case.[1] It seems inconceivable that such a statement could be calmly made, seeing how entirely contrary it is not only to the experience of all who have tried the experiment, with the single exception of Mr. McGuire, but also in direct opposition to all the evidence on the subject. Can Mr. McGuire point out a single instance of a polished implement being found on an admitted palæolithic site? He gives no such instance, and as it would form the strongest point in his whole argument if he could quote one, we may presume that he does not. That being so, surely it is fighting the air to bring a long array of his own experiments to prove that palæolithic man *ought* to have found out what he considers the easiest way of making his tools.

It may be well to make the point at issue quite clear by stating that there is no question of the polishing or grinding of an implement caused *by use.* Such an instance, probably more than one, of the chipped edge of a tool of palæolithic age being worn or ground by applying it to its destined work, has occurred. But it has never been urged that the effect thus produced was part of the original design.

Before leaving this branch of the enquiry I would fain quote Mr. McGuire's peroration. He says that palaeolithic man

---

[1] I say "seems to assert," for though the point at issue is the making of palaeolithic implements, yet Mr. McGuire uses the indefinite term "stone" when he should say "flint."

"had knives with which he could cut various articles and needles with which to sew; he knew the art of making and burning pottery; could and did make fire; he drilled holes of large and small size in bones, antlers, shells and fossils, and was familiar with the art of engraving at a period contemporaneous with the Mousterian implement and a quaternary fauna. With such evidence can it be argued that man was ignorant of a knowledge of the process by which stone was battered and ground in to shape and yet familiar with the more complicated art of chipping?"

On the other side I would put the man of the eighteenth century. He was familiar with the learning of two thousand years preceding his own time; he knew and practised the art of printing; he was an accomplished chemist and astronomer; he was an admirable artist in painting, sculpture and music; was a student of the forces of nature; traversed the whole world for the improvement of his mind or the bettering of his fortunes; he was expert in the beautifying of his every day surroundings of furniture and the accessories of a luxurious home. With such evidences should it not be argued with far greater force that he must have known that under the lid of his boiling tea-kettle, a utensil of daily use, lay a force that would carry him over land or sea five times more swiftly than the swiftest horse? Yet it is remarkable that he never thought of the application of the power of steam.

One word about the "purely archæological standpoint." This seems, in Mr. McGuire's view, to resolve itself into "the character and size of the chips detached appearing identical as do the so-called implements when laid one beside the other;" for, on the same page, he says, "Taking the type of the implement as a criterion of antiquity, America, Europe and Asia stand on the same footing." This, however, is the most dangerous criterion that could be taken. Even in Europe where the material used and the character of the sites are nearly alike, the type of implement alone is by no means a certain indication of age. I have seen hundreds of undoubted neolithic implements of far ruder work than an ordinary implement from the drift. And there is every reason why it should

be so. The material used is the same, and we have no ground for supposing that the process of manufacture was different. When, however, the types of one Continent are used as a criterion, by superficial resemblance alone, for determining the date of similar implements from another and distant Continent, the conclusions arrived at can obviously be of no value whatever.

I have long thought that a prominence totally undeserved has been given to the rule of thumb distribution that "chipped — polished = palaeolithic, and chipped + polished = neolithic." Its only virtue is its convenience and that it is easy to remember. But to exalt it to the dignity of a determinative factor is, I think, a great mistake, and I feel sure that many ardent collectors of stone implements cling to this accidental distinction as their sheet-anchor for data. The fact that palæolithic man overlooked the polishing of his implements is a mere accident, a subsidiary and incidental peculiarity, and possesses no right whatever to the importance it has attained. It has not the least value in determining whether an implement is of one or the other period. The converse of the proposition does not, of course, hold good in our present state of knowledge. If a polished implement of flint be found, it can safely be declared non-palæolithic, for the reason that up to now no implement with a designedly ground surface has been found on a palæolithic site. It would be of the greatest service in this particular if some fortunate searcher could light upon a hoard of polished palæolithic flint tools. Then it is possible that the true determination of palæolithic as opposed to neolithic would obtain proper recognition; that it does not rest upon the slender evidence of "chipping only," but upon a far more solid foundation, to wit, the evidence of the bed in which it lies.

To the observer in Europe the whole question of what is known as palæolithic man in America seems to be in a chaotic state. There appear to be many reasons for this. One principal one is, without doubt, the unfortunate reliance upon a particular type of implement as a distinguishing character of palæolithic deposits. Granted that such a type has a deter-

minative value in Europe, by what process of reasoning can it be argued that man, living thousands of miles away, has produced the same peculiar variety, simply because he lived with a similar group of extinct animals? Another reason, perhaps equally potent, is that only a very limited number of the students of early man in America have made any lengthened study on the spot of the conditions under which these remains are found in Europe. If the conditions are to be similar in America, then this would appear to be a necessity. If they are unlike, as is very possible, yet there must be sundry points of resemblance, and it is surely of value to proceed to the study of the unknown by familiarizing the mind with the date of a known and accepted condition. To sum up in a few words—let intelligent observers, trained to use their eyes, knowing what constitutes evidence, and capable of recording it, let such men work over the possible sites of the American Continent, and the result of their labors will, without any doubt, be of the greatest value to science, whether palæolithic man be found or not. But it is of the first importance that the explorers be trained men. The investigations of men without the necessary knowledge not only causes the results to be of little present value, but their work destroys the very evidence upon which alone true knowledge can be founded.

ZOOLOGY IN THE HIGH SCHOOL.[1]

BY CLARENCE M. WEED.

I do not see how the program recommended by the Natural History Conference of the Committee of Ten[2] can escape the charge of being inadequate and one-sided. According to it, eight years of study of at least two periods each week are to be devoted to plants before the high school is reached. This study includes not only the various parts and functions of the higher plants, their classification and life-histories, but the lower plants as well. Then in the high school five exercises a week for one school year are to be devoted to what can be considered only as a systematio review of knowledge already acquired. In all the twelve years of school life no provision is made for the study of animals, except a brief term of physiology, unless the advice of the conference is ignored and zoology is substituted for botany in the high school course. Truly it would appear that the much abused term—natural history—is to be restricted once more and become a synonym of botany. That the Conference did not intend to restrict the nature study of the lower schools to plants is abundantly shown by their answers to the questions submitted by the Committee of Ten, in which they distinctly recommend the study of both plants and animals for these grades.

The Conference "agreed that the year of study in natural history, recommended as a minimum for the high school, should be a consecutive year of daily recitations or laboratory work, and it is better to have the year's work devoted to one subject, either botany or zoology,.than to have it divided between the two." Two years have passed since this opinion was promulgated, and while it may have represented the best educational ideas concerning the study of biology then, there

---

[1] From a paper read before a High School Teachers' Institute, Concord, N. H., Sept. 21. 1894.

[2] Rept. of Committe on Secondary School Studies, pp. 138–158., U. S. Bereau of Education.

is abundant evidence to show that it does not to-day. For there are many indications that biological teachers are accepting and adopting the dictum long since enunciated by Huxley that "the study of living bodies is really one discipline, which is divided into zoology and botany simply as a matter of convenience." Nothing shows this more clearly than the general adoption of such books as Huxley & Martin's Course of Elementary Instruction in Practical Biology, Parker's Lessons in Elementary Biology, Dodge's Introduction to Elementary Practical Biology, and Boyer's Laboratory Manual in Elementary Biology. These books are designed for use in the high schools and colleges, and unquestionably represent the consensus of opinion among the most successful biological teachers. They show that the study of living things can easily be carried on in a consecutive course in which the student may obtain a basis of sound biological knowledge concerning the organisms on both sides of the imaginary fence which separates the plant and animal world. I doubt if any fair-minded zoologist would think of insisting on confining the biological training of high school students to animals, for it would be a one-sided and inadequate training introducing the pupil to one phase of nature when he is entitled to an introduction to both. No more should the botanist claim an exclusive privilege in this respect.

The reasons given by the Conference report for choosing botany instead of zoology are three, viz.: (1) "Because the materials for the study of that subject are probably more easily obtained than those for the study of zoology; (2) Because the study of plants is more attractive to the average pupil; and (3) Because, in the study of animals, many prejudices or aversions have to be overcome." Obviously, these last two causes should be considered as one, the explanation of the greater attractiveness of plants must largely be found in the prejudices and aversions to animals. My own experience in teaching both subjects leads to the opinion that there is little weight to be given the argument on either side: some students prefer one subject and some the other, but the greatest enthusiasm is always aroused by the study of animals like Vorticella, whose

life processes are watched in the field of the microscope. As to the first reason, the probable greater ease of procuring botanical material, the probability was not justified by the recent experience of Mr. C. H. Clark and myself at the New Hampshire College Summer School of Biology. We there went over, with nearly twenty teacher-students, the work in botany and zoology recommended in the programs of the Natural History Conference Committee, the afternoon sessions being devoted to botanical instruction by Mr. Clark, and the morning sessions to zoological instruction by myself. We both spent much of our spare time foraging for supplies, but I think Mr. Clark had the more difficult task of the two. Evidently these reasons are open to question, and, in any event, as mere reasons of expediency, they should give way to the larger considerations involved in other phases of the subject.

The limits of time forbid present discussion of the many claims of biology as a whole upon modern education, but I may say in passing that one of the most important of these claims is to be found in the relations of biological science to the philosophical problems of the day. Our philosophy is so permeated with the evolutionary phraseology that a knowledge of biological terms and processes is essential to the daily reading of an intelligent man. Such knowledge cannot be adequately obtained from the study of either plants or animals alone.

I believe that the position of a large proportion of biological teachers in America concerning biology in the high schools may fairly be represented by the following propositions: (1) That biology should be taught rather than either botany or zoology alone; (2) That the course should cover two years of at least three periods a week if possible, if not, that it cover as much time as can be spared to it, the minimum being one year; (3) That in general the time should be about equally divided between animals and plants, and that the study of the latter should come first, although some simple animal cells may well be studied at the start in connection with the lowest plants; (4) That the instruction should be given by means of the laboratory method of individual study of organic types, beginning with

the lower forms and proceeding upward in the scale of life; (5) That the methods employed should aim to develop the faculties of the student as well as to add to his store of knowledge—should be educative as well as instructive; and (6) That the laboratory work should be supplemented to as great an extent as possible by field excursions and outside reading.

It is scarcely necessary at this time to emphasize the importance of the laboratory method of studying biology. It is the only possible way; and if it cannot be adopted the boys had better be turned out in the woods to study nature first hand there. They will thus gain more useful knowledge and experience than they possibly could from the old-fashion textbook of zoology in which the student was introduced through a dead language to a much deader world. The equipment of a biological laboratory need not be very expensive. The essential furniture will consist of low simply-constructed tables with accompanying chairs, shelf-room and window-space. Each student should be provided with a compound microscope which can be purchased for $17.00, and a few simple accessories. Glass jars of some form—nests of beakers of larger sizes are excellent—should be provided for aquaria, and some simple reagents and dissecting dishes are necessary.

The logical method of commencing the study of zoology unquestionably is to study the lowest forms first and proceed in natural sequence to the higher ones. The student thus acquires a philosophic view of the animal kingdom and of the method of its development. He studies first the cell in the manifold modifications which it assumes in the one-celled animals; then he sees cells remaining connected superficially to form the simplest metazoa, and finally studies their myriad combinations in the higher animals. He proceeds from the simple to the complex—studies the materials of construction before studying the completed structure. The chief objection that has been raised to this method is that the student is required to begin the subject with high powers of the microscope—an instrument with which he may not be familiar—and that by means of it he is suddenly introduced to new and strange forms of life. This objection has been urged with

force by the master-teacher of modern biology, Professor Huxley, who, in the revised edition of his Course in Practical Biology, begins with the frog and works downward. That the experience of American teachers does not lead them to attach so much importance to the objection is shown by the fact that all of the authors of our best laboratory manuals—such as those of Dodge, Bumpus, Brooks and Boyer—have adopted the method of proceeding from below upward, and I think the practice of a majority of biological teachers points in the same direction. Possibly the aptness of American boys and girls in mastering such details as those of microscopic technique may account for the difference in the practice.

A serious objection to beginning the study of zoology with the frog or any higher animal is that it involves putting the student to the work of dissection before his interest is aroused. To many boys and more girls this is sufficient to give them a dislike to the whole subject. But if they first study living animals by watching their movements beneath the microscope, their interest can be so aroused that they can be led to simple dissections without difficulty. Many of them, indeed, will be so charmed with the work that they will echo the sentiment of the young lady at a leading New England college who is credited the enthusiastic remark that "Earthworms are perfectly lovely, especially the inside."

The teacher should adopt one of the newer laboratory guides, selecting the one that seems best adapted to the needs of the class and the time to be given to the subject, and having devoted a preliminary exercise to the use of the microscope, should start the students in individual studies of the types treated of in the guide. Abundance of material should be provided, and the students should be taught to rely upon their own resources to as great an extent as possible. At first they will need constant assistance, but later they will become more independent. Drawings and full notes are to be required.

An important part of the educational value of a laboratory course in biology depends on the requirements as to the student's notes. If one adopts the somewhat common practice of

allowing the student to follow the laboratory guide in his notebook, often answering questions by number with a yes or no, the results will be far from satisfactory. In my own classes I have adopted the method of writing upon the blackboard a definite subject, *e. g.*, "A Description of the Structure and Biology of the Amoeba," upon which I require an original essay embodying the results of the student's observations, and such additional explanations as I have given the class at the time the animal was studied. These essays are written upon one side of the letter size paper that goes between clip binders. The drawings are incorporated in the proper places with explanations beneath, the aim being to make all as clear and concise as it should be in a book. These essays are submitted once a week, and if not satisfactory are rewritten. I hope soon to arrange a coöperation with the English department so that the essays may count as English exercises and be reviewed from the rhetorical point of view. Very decided progress has resulted from this method which seems to me the most desirable mode of note-keeping in such laboratory work.

But the ordinary laboratory manual by no means includes all of the "pedagogical contents of zoology." In general it confessedly covers with fair completeness only the morphological side of the subject and leaves almost or quite untouched important phases of the science which should never be ignored. To guide a student along the morphological road is unquestionably the safest and surest way of leading him to a sound basis of biological knowledge, but every opportunity should be taken to point out to him the objects of fascinating interest that are found beside the way. Failure to do this leads to the production of those near-sighted naturalists, who, in the expressive words of Professor Forbes, " must have nature boiled in corrosive sublimate solution and fried in paraffine and sliced by a microtome before they care for it." These are not the nature students the high schools wish to produce. Broadness, not narrowness, is here the aim; and the results in this respect will depend largely on the culture, enthusiasm and preparation of the teacher.

The most important general result to be taught in connec-

tion with morphology is that of physiology. So far as possible the study of function should coincide with the study of form. To a considerable extent the newer laboratory manuals provide for this, especially in the lower groups of animals. Emphasis should be laid upon this side of the subject, and explanations be reiterated until the student masters each detail. In the same connection—and here is one of the most important phases of zoology—the teacher should develop those laws of life which give to biology its greatest interest, such as the law of the physiological division of labor and of structural progress from simple to complex; the relation of the one-celled animal to the multicellular one; the similarity of individual development to that of the group; the significance of the nucleus; the phases of reproduction; the facts of biogenesis and abiogenesis, of homogenesis and heterogenesis; the relations of parasitism to degeneration; the differences between plants and animals; the infinity of variations; the main facts of mimicry and protective resemblance; the effects of heredity and environment; the elements of natural selection, and an outline of the theory of organic evolution.

Perhaps you think this is laying too great a burden upon the teacher: it need not, for he may find an admirable, though concise discussion of these principles in Parker's Elementary Biology, and a more elaborate account of many of them in Lloyd Morgan's Animal Life. He should also have at hand for familiar reference Wallace's Darwinism, Poulton's Colors of Animals, Beddard's Animal Coloration, Rolleston's Forms of Animal Life, the Standard Natural History, the important zoological text-books, and as many other similar works as possible.

Perhaps the next most essential feature of the zoological course is a knowledge of the main outlines of animal classification. Not many years ago zoology was taught as if it consisted only of classification, and the inevitable reaction has gone so far that at present there is a tendency to ignore it altogether. This, however, is to be deplored. Classification is an essential feature of the science and should receive due consideration. Here the safest guide for the American teacher is

the Standard Natural History which should be in every school library as a work of reference.

Much can be done in arousing the student's interest by means of field excursions and outside reading. These excursions should be taken as frequently as they conveniently can be, and be under the personal supervision of the instructor. Inland schools should plan, if possible, at least one trip to the seaside, choosing a time when the tide will be out during the visit, where crabs, sponges, starfishes, sea-urchins and anemones may be studied as well as sea-lettuce, rock-weeds and many other forms of plant and animal life.

The amount of collateral reading that may be done will vary with the conditions of the school and the interests of the individual student. Biology opens to one an enormous field of literature of fascinating interest in which the teacher should always be browsing; and if wise he will lead his flocks to the feet of the master-minds who have ever found joy and inspiration in the green pastures and beside the still waters, where dear old Mother Nature is always ready to receive our worship and breathe a benediction upon our holiest aspirations.

New Hampshire College, September, 1894.

EDITORIALS.

—THE International Geological Congress met at Zurich, commencing on August 29th, and continuing until September 1st, inclusive. On the third of September the Congress started on an extended excursion through the Alps for examination of the geological features en route. Numerous important papers were read, but no official expression as to rules or modes of proceedure in geology were issued or discussed. The most important proposition in this direction had reference to the organization of the congress itself. Dr. Fraser of this city offered the following resolution, "with reference to the organization of the next congress." "(1) To what extent does the Congress recognize the right of Government bureaus as such, or of societies, or any other organization, to send delegates to the congress? (2) Within what limits does the Congress recognize the right of these representatives, or of a part only of the members of the Congress which come from the same country, to designate the Vice-President representing their country, or to act without coöperation with their compatriots in the Congress.?"

This resolution was rendered necessary by the arbitrary action of the president Prof. Renevier, in electing as Vice-President representing the United States, a person who was not present, but who had been recommended for the place by letter. The person so elected is a member of U. S. Geological Survey, and although this fact could not debar him from the position, his appointment under such circumstances brought into prominence the question as to the relative claims of various bodies to appointment to the official positions in the Congress. Since the Committee which originally represented the United States was driven out of existence, owing to the contributive neglect of some of its members, this country has no official representation in the Congress. Hence the propriety of the resolution offered by Dr. Fraser. An easy solution of the question would appear to be suggested by the language of the resolution. That is that the members in attendance from a given country, should get together in advance, and nominate their candidates for presentation to the congress.

—IT is proposed by the Filson Club of Louisville, Kentucky, to publish a work on the life and writings of Constantine Samuel Rafinesque by the well known zoologist, Dr. R. Ellsworth Call. An extract from the preface says:

"This memoir had its inception in an attempt to clear up certain matters connected with the synonymy of a large and important group of fresh-water mollusks—the Unionidæ. A number of very remarkable facts connected with the personality of its subject were thus incidentally learned. As the collation of data proceeded, the facts learned seemed of sufficient importance to group them for presentation to the literary and scientific world in the hope that a better and more intelligent understanding of the work of this eccentric naturalist might result. A number of impressions were forced upon my attention as the work proceeded; among other conclusions reached, was the one that Rafinesque had not been always fairly treated by his cotemporaries. Resulting from this was the conviction that many naturalists now living have formed opinions concerning the nature and value of Rafinesque's work which appear to me to be quite erroneous. In the hope that some of these misapprehensions might be corrected, the task of writing his life, which is quite a labor of love, was undertaken."

The prospectus goes on to say "the publication will be in the sumptuous quarto form adopted by the Filson Club, and issued in paper only. It will contain several full page illustrations, one of which will be a portrait of its subject. A complete bibliography of the writings of Rafinesque on every subject, comprising over four hundred titles, will be included, together with a certified copy of his will, one of the most remarkable testamentary documents ever probated," etc.

The gentlemen engaged in this enterprise probably think that they are conferring a benefit on contemporary and future science by issuing this publication. We wish to state that in our opinion the money devoted to it might be expended in a much more profitable direction. A reprint of Rafinesque's botanical and zoological papers, so that they can be made accessible to students, would be far more useful to science, and we are glad to notice that the same publishers (Jno. P. Morton & Co.) propose to issue a reprint of the Ichthyologia Ohiensis. We do not mean to intimate, in making this suggestion, that the works of Rafinesque ever had more than a very moderate scientific value, but he has added so much to the nomenclature that it ought to be possible to refer easily to them, whereas now many of them are inaccessible to most naturalists.

Rafinesque is well known as a most careless writer who inflicted endless difficulties on his successors. Some of the matter of his papers is fictitious, and much of it of such an indefinite character that it should not be admitted into scientific literature. Some naturalists have been at great pains to identify his species, but such identifica-

tions will be ultimately set aside, when a more critical spirit prevails among species zoologists. Money is so badly needed for scientific research and its publication, that it is melancholy to notice its perversion to such an object. It is also difficult to understand how any one who understands the true needs of science can devote his time to writing such a book. In concluding these remarks, we wish to emphasize the fact that Mr. Rafinesque was not a Kentuckian, nor an American, so that patriotic (!) motives can scarcely enter into the proposition.

—IT is greatly to be hoped that the newly established Botanical Society of America can be induced to hold at least some of its meetings at the same times and places as the societies of Naturalists, Morphologists and Physiologists, for not a few will be members of more than one of these organizations, while there are many questions like those of evolution, heredity, geographical distribution, studies of the cell and of protoplasm, which, whether presented from the zoological or the botanical side are of equal interest to all. We notice that the provisions of the constitution of the new society are in effect that annual and special meetings are to be held at times and places appointed by the council, so that there is, in this respect, no trouble in affiliation with the older organizations.

—PROFESSOR W. W. NORMAN of De Pauw University goes to the place in the University of Texas recently vacated by C. L. R. Edwards, now of Cincinnati. In view of the treatment experienced by Dr. Edwards, the position can hardly be said to be a desirable one, and we withhold our congratulations until we see whether the university authorities know more or are more sensible of the advances of science than they were a few months ago. The best we can do is to extend our sympathies.

The numbers of the American Naturalist for 1894 were issued at the following dates: January, Jan. 25; February, Feb. 17; March, Mch. 8; April, Apl. 2; May, May 4; June, June 1; July, July 13; August, Aug. 14; September, Sept. 15; October, Oct. 10; November, Nov. 8; December, Dec. 5.

RECENT BOOKS AND PAMPHLETS.

ALLEN, H.—A Monograph of the Bats of North America. Bull. No. 43, U. S. Natl. Mus. From the Smithsonian Institution.

ALLEN, J. A.—Cranial Variations in *Neotoma micropus* due to Growth and Individual Differentiation.——Remarks on specimens of *Chilonycteris rubiginosus* from Western Mexico, and on the Color Phases of *Pteronotus davyi* Gray. Extr. Bull. Am. Mus. Nat. Hist., Vol. VI, 1894. From the author.

BARCENA, M.—El Clima de la Cuidad de Mexico. Mexico, 1893.

——Selvicultura Breves Consideraciones sobre Explotation y formacion de los Bosques. Mexico, 1892. From the author.

BECKER, G. F.—On certain Astronomical Conditions favorable to Glaciation. Extr. Am. Jour. Sci., Vol. XLVIII, Aug., 1894. From the author.

BROWN, A. E.—On the True Character and Relationships of *Ursus cinnamomeus* And. and Bach.

BUCKMAN, S. S. AND BATHER, F. A.—Can the Sexes in Ammonites be distinguished? Extr. Nat. Sci., Vol. IV, 1894. From the authors.

Carte de la France dressée par le Service vicinal par ordre du Ministre de l'intérieur à l'Echelle du 100,000 éme.

DAY, D. T.—Mineral Resources of the United States for the calendar year 1893. Washington, 1894. From the U. S. Geol. Survey.

DEAN, B.—Contributions to the Morphology of Cladoselache. Extr. Journ. Morph., Vol., IX, 1894. From the author.

DILLER, J. S. AND SCHUCHERT, C.—Discovery of Devonian rocks in California. Extr. Am. Jour. Sci., Vol. XLVII, 1894. From C. Schuchert.

GUYARD, E.—Comparaison schematique du soleil de la terre. Paris, 1894. From the author.

EIGENMANN, C. H.—On the Viviparous Fishes of the Pacific Coast of North America. Extr. Bull. U. S. Fish Commission for 1892. Washington, 1894. From the author.

Eleventh Annual Report of the Board of Control of the State Agricultural Experiment Station at Amherst, Mass. Boston, 1893.

ELLIOTT, W. C.—A History of Reynoldsville and Vicinity. Reynoldsville, 1894.

EMMONS, S. F.—Geological Guide-Book for an Excursion to the Rocky Mts. Extr. Compte-Rendu of the Fifth Internatl. Congress of Geologists. New York, 1894. From the author.

HERRERA, A. L.—El Hombre Prehistorico de Mexico. Extr. Mém. de la Soc. Alzate de Mexico, T. VII. From the author.

HINRICHS, G.—Centenary Commemoration of Antoine-Laurent Lavoisier. St. Louis. 1894. From the author.

HOLLICK, A.—Additions to the Paleobotany of the Cretaceous Formation on Long Island. Extr. Bull. Torr. Bot. Club, Feb., 1894.——Some Further Notes on the Geology of the North Shore of Long Island. Extr. Trans. N. Y. Acad. Sci., XIII, (1894). From the author.

JOUY, P. L.—Notes on Birds of Central Mexico with Descriptions of Forms believed to be new. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1894. From the Smithsonian Inst.

KEMP, J. F.—Gabbros on the western shore of Lake Champlain. Extr. Bull. Geol. Soc. Am., Vol. 5, 1894. From the Geol. Dept. of Columbia College.

KEMP, J. F. AND HOLLICK, A.—Granite at Mount Adam and Eve, Warwick, Orange Co., N. Y., and its contact phenomena. Extr. Ann. New York Acad. Sci., Vol. VII. From the authors.

KEMP, J. F. AND MARSLERS, V. F.—Trap Dikes of the Lake Champlain Region. Bull. No. 107, U. S. Geol. Surv. Washington, 1893. From Mr. J. F. Kemp.

LANDIS, C. K.—Autobiographical Sketch of a Tree. No date. From the author.

LOCY, W. A.—Metameric Segmentation in the Medullary Folds and Embryonic Rim. Extr. Anat. Anz., IX, Bd. Nr. 13. From the author.

LONSDALE, E. H.—Southern Extension of the Cretaceous in Iowa. Extr. Proceeds. Iowa Acad Sci., 1893. From the author.

MANTIA, P.—L'Eredita et L'Origine delle Specie. Palermo, 1894. From the author.

MASON, O. T.—Migration and the Food Quest. A study in the peopling of America. Extr. Amer. Anthropol., July, 1894. From the author.

MOCQUARD, M.—Sur l'existence d'une poche axillaire chez certains caméléons. Extr. Compte-Rendu Soc. Philom., Paris, 1893. From the author.

Ninth Report on the Injurious and other Insects of New York for the year 1892. Albany, 1893. From J. A. Lintner, State Entomologist.

PIETTE, E.—L'Epoque Eburnéenne et les races humaines de la periode glyptique. Saint-Quentin, 1894. From the author.

Report for the year 1893-94, presented by the Board of Managers of the Observatory of Yale University to the President and Fellows.

Report of the U. S. National Museum for the year ending June 30, 1892. From the Smithsonian Inst.

SCHLOSSER, M.—Literaturbericht für Zoologie in Beziehung zur Anthropologie mit Einschluss der lebend und fossilen Säugethiere für das Jahr, 1891. From the author.

SCOTT, W. B.—Mammalia of the Deep River Beds. Extr. Trans. Amer. Phil. Soc., Vol. XVII, 1893. From the author.

Second Weekly Weather Crop Rulletin issued by the North Carolina State Weather Service April 16, 1894.

SEELEY, H. G.—Further Observations on the Shoulder-Girdle and Clavicular Arch in the Ichthyosauria and Sauropterygia.——Researches on the Structure and Classification of the Fossil Reptilia. Part VIII.——On Further Evidences of Deuterosaurus and Rhopalodon from the Permian Rocks of Russia. Extr. Proceeds. Roy. Soc., Vol. 54. From the author.

SMITH, E. A.—Geological Surveys in Alabama. Extr. Jour. Geol., Vol. II, 1894. From the author.

SPURR, J. E.—The Iron-Bearing Rocks of the Mesabi Range in Minnesota. Bull. No. 10, Geol. and Nat Hist. Surv. Minn. From Prof. N. H. Winchell.

STANTON, T. W.—The Colorado Formation and its Invertebrate Fauna. Bull. No· 106 U. S. Geol. Surv. Washington, 1893. From the Survey.

Trouessart, E.—Appendice à la Révision des Acariens des Régions Arctiques. ——Acariens des Régions Arctiques recueillis pendant le voyage de "La Vega." Extr. Mém. de la Soc. nat. des Sci. nat. et Math. de Cherbourg, T. XXIX. From the author.

True, F. W.—Diagnosis of North American Mammals. Extr. Proceeds. U. S. Natl. Mus., Vol. XVII, 1894. From the author.

Webb, Dr. W.—The Shell Heaps of the East Coast of Florida. Extr. Proceeds. U. S. Natl. Mus., Vol. XVI, 1893. From the Smithsonian Institution.

White, D.—Flora of the Outlying Carboniferous Basins of southwestern Missouri. Bull. No. 98, U. S. Geol. Surv. Washington, 1893. From the author.

Wortman, J. L.—On the Affinities of *Leptarctus primus* of Leidy. Extr. Bull. Am. Mus. Nat. Hist., Vol. VI, 1894. From the author.

RECENT LITERATURE.

Seitaro Goto.—Studies on the Ectoparasitic Trematodes of Japan.[1]—This volume forms one of the most important pieces of work which has ever been written on the ectoparasitic trematodes, and is the result of about four years of careful and exact study. In the first part (176 pgs.) of the work, the author treats the anatomy in detail; then follow several pages of biological notes, a detailed account (pp. 182–253) of the classification, analytical key (pp. 254–261) to genera and species described, bibliography (pp. 262–267), and 27 finely drawn and well executed plates. Revised generic and specific diagnoses are given, together with a historical review of the different genera.

The following genera and species are described:—

I. MICROCOTYLE B. & H., 1863:—
  1. *M. caudata* n. sp., gills of *Sebastes* sp. sp.;
  2. *M. sebastis* n. sp., gills of *Sebastes* sp. sp.;
  3. *M. elegans* n. sp., gills of *Scombrops chilodipteroides;*
  4. *M. reticulata* n. sp., gills of *Stromateus argenteus;*
  5. *M. truncata* n. sp., gills of *Pristipoma Japonicum;*
  6. *M. fusiformis* n. sp., gills of *Centronotus nebulosus;*
  7. *M. chiri* n. sp., gills of *Chirus hexagrammus;*
  8. *M. sciænæ* n. sp., gills of *Sciæna sina;*

II. AXINE Abildg., 1794:—
  9. *A. heterocerca* n. sp., gills of *Seriola quinqueradiata;*
  10. *A. aberrans* n. sp., gills of *Belone schismatorhynchus;*
  11. *A. triangularis* n. sp., gills of *Anthias Schlegelii;*

III. OCTOCOTYLE Dies., 1850:—
  12. *O. major* n. sp., gills of *Scomber colias;*
  13. *O. minor* n. sp., gills of *Scomber colias;*

IV. DICLIDOPHORA Dies., 1850:—
  14. *D. smaris* Ijima MS., mouth-cavity of *Smaris vulgaris*, on caudal segment of a Cymothoa;
  15. *D. elongata* n. sp., mouth-cavity of *Pagrus tumifrons*, occasionally on the Cymothoa in the oral cavity;
  16. *D. sessilis* n. sp., oral cavity of *Choerops Japonicus;*
  17. *D. tetrodonis* n. sp., gills of *Tetrodon* sp., sp.;

V. HEXACOTYLE Blainv., 1828:—
  18. *H. acuta* n. sp., gills of *Thynnus sibi;*
  19. *H. grossa* n. sp., gills of *Th.* sp.;

VI. ONCHOCOTYLE Dies., 1850:—
  20. *O. spinacis* n. sp., gills of *Spinax* sp.;

VII. CALICOTYLE Dies., 1850:—
  21. *C. Mitsukurii* n. sp., cloaca of *Rhina* sp.?;

VIII. MONOCOTYLE Tschbrg., 1878:—
  22. *M. Ijimae* n. sp., oral cavity of *Trygon pastinaca;*

---

[1] Journ. College of Science, Imp. Univ., Tokyo. Vol. VIII, Part I, 1894, 273 pgs., 27 plates.

IX. EPIBDELLA Blainv., 1828: —
  23. *E. Ishikawae* n. sp., gills of *Lethrinus* sp.?;
  24. *E. ovata* n. sp., gills of *Anthias Schlegelii;*
X. TRISTOMUM Cur., 1817: —
  25. *T. sinuatum* n. sp., gill-plates of *Histiophorus* sp.;
  26. *T. ovale* n. sp., oral cavity of *H. orientalis*, H. sp., and? *Cybium*;
  27. *T. rotundum* n. sp., gills of *Xiphias gladius;* .
  28. *T. foliaceum* n. sp., gills of gen. sp. (Japanese Hazara);
  29. *T. Nozawae* n. sp., fins of *Thynnus sibi;*
  30. *T. biparasiticum* n. sp., carapace of a copepod (*Parapetalus*) and gills of *Thynnus albacora.*

It is somewhat striking that of all the thirty Japanese species described, the author does not consider a single one identical with any forms heretofore mentioned, but when one looks at the magnificent anatomical work contained in this volume he certainly feels very far from calling specific determinations into question.

Several points in Goto's interpretation of anatomical and histological structures are worthy of special notice: —

1. The prismatic, refractive fibres, which constitute the wall of the suckers in the genera *Axine, Microcotyle, Octocotyle, Diclidophora, Hexacotyle* and *Onchocotyle,* are usually looked upon as muscular fibres, but Goto agrees with Wright and Macallum (in *Spyranura*) in considering these fibres more of a non-contractile supportive, connective tissue nature.

2. The penis "is to be regarded as formed by an elevation of the wall of the genital atrium around the opening of the vas deferens and a simultaneous displacement of the latter from the base of the penis towards its top; so that the cavity of the penis is morphologically speaking as much the external surface of the body as the genital atrium, and the prostate glands are therefore to be regarded as a special modification of the dermal glands,—a view clearly in accordance with some facts observed [by Haswell] in Temnocephala."

3. Agreeing with Looss, Goto considers the vagina of the Cestoda homologous with the uterus of the Trematoda. Laurer's canal of the Digenea is homologized with the genito-intestinal canal of the ectoparasitic Trematoda, the receptaculum vitelli of *Aspidogaster* and the "anterior blind vagina" of *Amphilina.* While Looss looks upon the uterus of the Cestoda as homologous with the Laurer's canal of distomes, Goto homologizes the uterus of the Cestoda with the vagina of the monogenetic Trematoda. These homologies are discussed at length and are diagrammatically figured on Pl. XXVII.

For important and interesting discussions of other histological and anatomical structures we must refer to the original work.

C. W. STILES.

General Notes.

PETROGRAPHY.[1]

Composite Dykes on Arran.—Professor Judd[2] describes a number of "composite" dykes on the Island of Arran, in which the well-known "Arran pitchstone" and a glossy augite-andesite occupy different portions of the same fissure, either rock appearing in the center of the dyke, with the other on one or both of its peripheries, or the one rock cutting irregularly through the other. The relations of the rocks indicate that there was no regular sequence in the intrusion, the pitchstone having been intruded sometimes before, sometimes after the andesite. Each rock contains fragments of the other (in different dykes), and the two rocks are always separated by a sharp line of demarkation. The andesite is a basic rock containing about 56 per cent of silica, while the pitchstone is a pantellerite with 75 per cent of SiO_2 or an augite-enstatite-andesite with 66 per cent of SiO_2 and 4.13 per cent K_2O. The andesite is well characterised. It passes into a tholeite with intersertal structure, by a decrease in the glassy component, and upon further loss of glass it passes into diabase. The pitchstone is largely an acid glass, surrounding crystals of quartz, and microlites of augite, feldspar, magnetite, etc. The author adds to the list of individualized components already known to exist in the rock hyalite and tridymite. The latter mineral occurs in plates aggregated into spherules and globules that surround quartz crystals, and the hyalite forms globules scattered here and there through the glass. The author thinks that materials of such widely different nature as that existing in these dykes could not have been formed by the differentiation of a magma after its intrusion into the dyke fissures, but that the differentiation must have taken place while the magma was still in its subterranean reservoir.

Analyses of Clays.—Hutchings[3] quotes a series of analyses of carboniferous clays to show that these substances possess the requisite composition to become clay slates upon compression. He ascribes the small percentages of alkalies shown in most clay analyses to the fact

---

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Quart. Jour. Geol. Soc., xlix, 1893, p. 536.

[3] Geol. Magazine, Jan. and Feb., 1894.

that these analyses are of commercially valuable clays, selected for their small alkali contents. In the course of his article the author corrects some of the statements made in earlier papers and amplifies others. He declares that newly formed feldspar is present in the slates metamorphosed[4] by the shap granite and in other contact slates. In the spots of the shap rocks, and in those of other contact slates, there is always present, in addition to its individual components, more or less of a yellowish-green very weakly polarizing substance in which the other components of the spot are imbedded. This is believed to possess an indefinite composition, and to be the result of aqueo-fusion of some of the constituents of the original rock and the solidification of the product in an amorphous condition. The paper concludes with a statement of the author's views concerning the transformations that rutile, biotite, quartz, feldspar, cordierite and other contact minerals undergo in cases of contact metamorphism.

The Phonolites of Northern Bohemia.—The phonolites of the Friedländer district of North Bohemia are nosean bearing trachytic phonolites and nepheline-phonolites, according to Blumrich.[5] The latter contain phenocrysts of anorthoclase in a groundmass of sanidine, nepheline and aegerine crystals and groups of a new mineral which the author calls hainite. This hainite is a strongly refracting but a weakly doubly refracting colorless substance. It occurs in tiny triclinic needles with a density of 3.184. These unite into groups. It is found also as well-developed wine-yellow crystals forming druses in cavities in the rock. The mineral has a hardness of 5, and it is optically positive. It is supposed to be closely related to rinkite, hjortdahlite and the other fluorine bearing silicates common to the eleolite-syenites. In addition to hainite the druse cavities contain albite, chabazite and nosean. In the trachytic phonolites a glassy base was detected.

Spherulitic Granite in Sweden.—Loose blocks of spherical granite are reported by Backström[6] from Kortfors, in Orebro, and Balungstrand in Dalekarlien, Sweden. The rock from Kortfors is a hornblende granitite containing concentric nodules composed of four zones. The inner one consists of oligoclase, microcline and quartz; the second of oligoclase in radial masses and small quantities of hornblende, biotite, magnetite, orthoclase and quartz; the third of hornblende, biotite, oligoclase and a little biotite, and the peripheral zone

---

[4] Cf. American Naturalist, 1892, p. 245.

[5] Min. u. Petrog. Mitth., xiii, p. 465.

[6] Geol. Foren. i. Stockh. Förh. 16, p. 107.

of magnétite in a matrix of oligoclase. The structure of the spheroids, with the younger minerals nucleally and the older ones peripherally distributed, indicates to the author that they were produced by liquation processes. The rock from Balungstrand possesses a coarse groundmass consisting almost exclusively of microcline and quartz. The spheroids are essentially oligoclase spherulites peripherally enriched by biotite. They are clearly older than the groundmass.

Diabase and Bostonite from New York.—A few dyke rocks cutting the gneisses of Lynn Mountain, near Chateaugay Lake, Clinton Co., N. Y., are described by Eakle[7] as consisting of olivine diabase and of bostonite. The latter rock is porphyritic with phenocrysts of red orthoclase in a fine-grained groundmass with the trachytic structure. It differs from the other bostonites of the region in the presence of much chloritized augite in its groundmass. It is also more acid than these. Its analysis gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Loss	Total
67.16	14.53	4.17	1.26	.41	6.10	5.55	1.10 =	100.28

The olivine diabase differs from the ordinary ophitic diabases in that much of its augite is in idiomorphic forms. They thus resemble Kemp's augite camptonites.

Petrographical News.—A very interesting series of analyses of rocks from the central and northeastern portions of the Mittelgebirge is given by Hibsch.[8] The series includes analyses of phonolites, dolerites, camptonites, nepheline and leucite tephrites, augitites and basanites. Many of the rocks have been described in the literature.

Cohen[9] has obtained from the Transvaal, Africa, specimens of a calcite bearing aplite and of a melilite augite rock of a somewhat abnormal character. The aplite is from the mine of the Iron Crown Gold Mining Co., near Hamertsburg, and the melilite rock from near Palabora. The melilite rock is a fine-grained aggregate composed largely of honey-yellow melilites and black augites. On its druse walls are little crystals of the first-named mineral, and through the druse cavities extend thin plates of copper. In the thin section, clear, colorless melilites, with rounded outlines and olive-green grains of augite are seen to lie in an opaque granular groundmass in which are dots and flakes of copper.

[7] Amer. Geologist, xii, p. 31.

[8] Min. u. Petrog. Mitth., xiv, p. 95.

[9] Minn. u. Petrog. Mitth., xiv, p. 188.

Backström[10] fused feldspathic phonolite and obtained as the product upon cooling a colorless glass filled with microlites of oligioclase, nepheline, small microlites of colorless pyroxene and tiny grains of picotite and olivine (?). Upon fusing a leucite phonolite, containing nosean, SO_3 is driven off and the resulting product is a glass enclosing microlites of oligoclase, a few prisms of nepheline and abundant crystals of a yellow pyroxene with the properties of aegerine.

[10] Bull. d. l. Soc. Franc. d. Min., 1893, xvi, p. 130.

GEOLOGY AND PALEONTOLOGY.

Ancient Conglomerates.—The presence of intra-formational conglomerates is a not uncommon phenomenon. Dr. Walcott notes several localities where this form of conglomerate occurs in Paleozoic limestone formations, and describes typical ones found in Vermont and New York, Pennsylvania, Virginia and Tennessee. The author defines this species of conglomerate as one formed within a geological formation of material derived from and deposited within that formation. As to their origin, he offers the following theory. Low ridges or domes of limestone were raised above the sea level and were subjected to the action of sea shore ice and the aerial agents of erosion. In the intervening depressions of these ridges calcareous mud was being deposited which was solidified soon after deposition. The material forming the conglomerate was transported from the shore line and dropped upon the sea bed by floating ice. The facts from which these inferences are drawn are given in detail. (Bull. Geol. Soc. Am., Vol. 5, 1894).

Subterranean Waters on the Coastal Plain.—N. H. Darton has published a brief review of the geological conditions under which subterranean waters occur in the Coastal Plain region of the middle Atlantic slope, together with an account of wells bored. He shows that the geological relations are favorable to the wide circulation of waters at several horizons, and gives the approximate vertical positions and general areal distributions of these horizons. In southern New Jersey, Delaware and a portion of Maryland, the sand series of the Chesapeake formation are the principal water producers. Along the western edge of the Coastal Plain from Petersburg to Staten Island, the basal members of the Potomac formation yield water at moderate depths. The author gives also the "prospects" in several districts. About Norfolk, water will probably be found on the crystalline floor, 1,500 feet below the surface; in the peninsula region of eastern Virginia and Maryland, at the base of the Chesapeake beds at depths varying from 100 to 400 feet; on the "eastern shore" of Maryland there are many favorable prospects, successful wells being in operation, drawing their supplies from the Chesapeake, 200 to 300 feet below the surface, and from the Pamunkey sands, reached by 350, 440 and 910 feet boring. (Trans. Am. Inst. Mining Eng., 1894).

The Shasta-Chico Series.—The protracted investigations of Messrs. Diller and Stanton concerning the Cretaceous formations of western United States result in an accumulation of data on which are based a number of interesting conclusions. The Knoxville, Horsetown and Chico beds of northern California and Oregon are found to be continuous series of deposits and the authors accordingly propose for them the name Shasta-Chico series. The Wallala beds represent a phase of the Chico. The Mariposa and Knoxville beds are distinct faunally and are unconformable. Ther former is Jurassic, the latter Cretaceous. The attentuation of the Shasta-Chico series westward from the Sacramento Valley and the overlapping of the newer beds upon the older crystalline rocks of the coast range shows that the coast range was formed before the deposition of the Shasta-Chico series, and probably at the close of the Jurassic when the Mariposa beds were upturned.

The subsidence of the whole Pacific coast from Alaska to Mexico is shown by the successive peripheral attenuation of the lower beds and the landmark overlapping of the upper ones. The subsidence was probably not uniform throughout the whole region.

The final folding of the Sierra Nevada rocks and an uplifting of the range occurred at the close of the Jurassic.

The Shasta-Chico series represents the Cretaceous time from the beginning of the Lower Cretaceous to the Middle of the Upper Cretaceous, and it may be closely correlated with the Queen Charlotte Island and Nanaimo groups.

The evidence from fossil plants indicates that the Potomac epoch is included in that represented by the lower part of the Shasta-Chico series. It is also highly probable that the Comanche series of Texas and Mexico is contemporaneous with a large part of the Shasta-Chico series. (Bull. Geol. Soc. Am., Vol. 5, 1894).

A Gypsum " Cloche."—While excavating stone for plaster in the southern borders of the forest of the Montmorency à Taverny (Seine-et-Oise) a *cloche*, or natural cavity, was found in a mass of gypsum. This *cloche* is ellipsoidal in form, about 10 metres in length, and 5 to 6 metres high. The top of the cavity presents the peculiar appearance resulting from the slow dessication of the homogeneous rock. The sides are polished, with the edges of all the angles rounded off. The floor is an irregular heap of gypsum blocks of various sizes. Certain parts of this cavity are lined with small gypsum crystals.

That the cavity is the result of the action of water is undoubted, and three hypotheses are given as to the manner of erosion. (1) The water may have entered from above or laterally and slowly dissolved the gypsum. (2) The water may have entered from below through a fissure acting as a natural siphon. (3) There may exist, beneath the mass exploited, a subterranean stream flowing over a second deposit of gypsum. The second mass having been dissolved and carried away by the water would leave a cavity into which the first mass would fall. The cavern thus formed would fill with water percolating through the fissures, from which would result the phenomena of solution and curious recrystallization of gypsum observed on the roof and sides of the *cloche.* (Feuille des Jeunes Naturalitses, no date).

The Malaspina Glacier.—The term Piedmont has been applied to glaciers formed on comparatively level ground at the bases of mountains where the ice is not confined by highlands. They are fed by Alpine glaciers which spread out and unite with each other on leaving the valleys through which they descend from snow fields at higher elevations. The only known example of this class is the Malaspina glacier which occurs in Alaska, on the plain intervening between the Mt. St. Elias range and the ocean. A detailed description of this phenomenon by I. C. Russell was recently published, of which the following is an abstract.

The Malaspina glacier extends westward from Yakutat Bay for 70 miles, with an average breadth of 20 to 25 miles. It is a nearly horizontal plateau of ice. The general elevation 5 or 6 miles from its outer border is about 1,500 feet. It consists of three lobes, each of which is practically the expansion of a large tributary ice stream. The largest has an eastward flow toward Yakutat Bay, and is fed by the Seward glacier. It ends in a low frontal slope, while the southern border skirts the coast and forms the Sitkagi bluffs. The middle lobe is the expanded terminus of the Agassiz glacier flowing toward the southwest. This lobe is complete, and is fringed all about its outer border by broad moraines. The third lobe results from the union of the Tyndall and Guyot glaciers; it has a general southward flow and pushes out into the ocean, breaking off forms of magnificent ice cliffs.

On the north border of the glacier the surface-melting gives origin to hundreds of rills and rivulets of clear sparkling water which course along in channels of ice until they meet a crevasse or moulin and plunge down into the body of the glacier to join the drainage beneath. In the southern portion of the glacier abandoned tunnels 10 to 15 feet

high made by englacial streams are sometimes revealed. The rapid melting of the surface ice produces curious phenomena. Where the ice is protected by belts of stone and dirt from the action of sun and air, the adjacent surface wasting away leaves ridges, while large isolated stones give rise to pinnacles and tables, but smaller ones, especially those of dark color, cause depressions.

The great central area of the glacier is composed of clear white ice which is bordered on the north by a broad, dark band of boulders and stones. Outside of this, forming a belt, concentric with it, is a forest covered area, in many places four or five miles wide. The forest grows on the moraine which rests upon the ice of the glacier.

The Malaspina glacier, in retreating, has left irregular hillocks of coarse débris which are now densely forest-covered. These deposits do not form a terminal moraine, but a series of irregular ridges and hills with a somewhat common trend. They indicate a slow general retreat without prolonged halts.

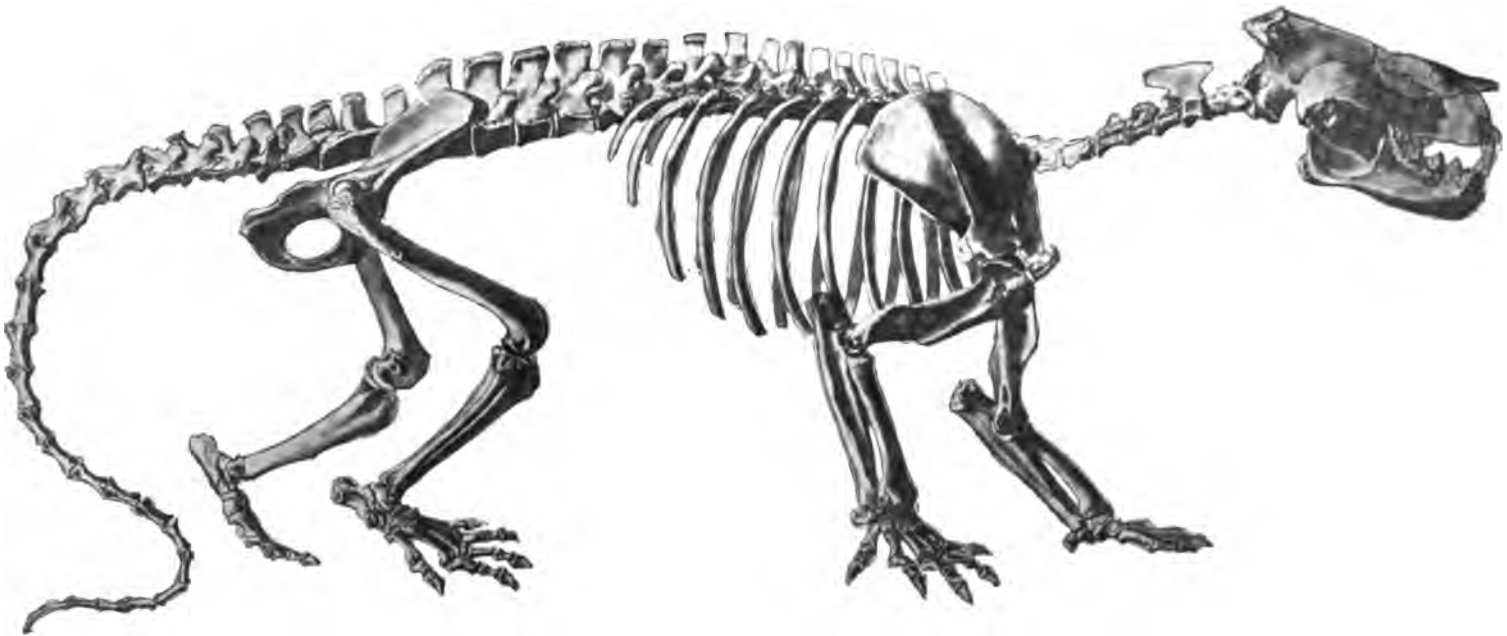
The outer portion of the barren moraine and the forest covered area characterized by innumerable lakelets from 100 feet to 200 yards across. They are generally circular and have steep walls of dirty ice which slope toward the water at high angles. Their presence in large numbers indicate that the ice must be nearly or quite stationary, otherwise the basins could not exist for a series of years.

On the west and north sides of the Chaix hills several typical "marginal lakes" occur similar to the well known Merjelen See of Switzerland.

The drainage of the Malaspina glacier is englacial or subglacial. Along the southern margin hundreds of streams pour out of the escarpment formed by the border of the glacier, or rise like fountains from the gravel accumulated at its base. All are brown and heavy with sediment. The most remarkable of these springs is Fountain Stream. It comes to the surface through a rudely circular opening, nearly 100 feet in diameter, surrounded in part by ice. Owing to the pressure to which the waters are subjected they boil up violently, and are thrown into the air to the height of 12 or 15 feet and sends jets of spray several feet higher. The waters rush seaward in a roaring stream 200 feet broad which soon divides into many branches, spreading a sheet of gravel and sand right and left into the adjacent forest.

About the southern and eastern borders of the glacier osars and alluvial cones abound. It is in this region that the ideal conditions for these formations exist. Here the ice sheet is stagnant on its border, and is retreating; it rests on a gently inclined surface, higher on

PLATE XXXIII.



Patriofelis ferox Marsh.

the southern margin than under its central portion, with high lands on the upper border from which abundant débris is derived.

There has been a recent advance and subsequent retreat of the glacier on its eastern margin. During its advance it probably extended to the ocean. There are several indications that the coast in the vicinity has been rising and that the process is still continuing.

Plistocene Problems in Missouri.—The three hypotheses as to the origin of the Boulder Drift and Loamy Clay in Missouri, north of the Missouri River, are briefly styled by J. E. Todd, the subglacial, the lacustrine and the fluviatile. The objection to the first is the great difference in altitude of the drift in Missouri and that in Illinois not fifty miles away, together with the absence of drift over Saint Louis County and down the valley of the Meramee, and also the apparent impossibility of the land ice reaching central Missouri without overflowing the Wisconsin driftless area. To the second and third hypotheses are opposed the nature of the deposits and the great width and depth of the troughs of the Missouri and the Mississippi Rivers. Todd confines himself to stating the problems without advancing any theory of explanation. Further research, he thinks, may remove the objections he finds in the last two and it is not improbable that the deposits may be accounted for by a combination of the lacustrine and fluviatile theories. (Bull. Geol. Soc. Am., Vol. 5, 1894).

Wortman on the Creodont Patriofelis.—Dr. J. L. Wortman has published, in the Bulletin of the Amer. Museum Nat. History of New York, a study of a remarkably perfect skeleton of the *Patriofelis ferox* Marsh, which he found in the Bridger beds of S. W. Wyoming. The species was described by Marsh under the name *Limnofelis ferox*. Limnofelis Marsh is shown, by the material described, to be synonymous with Patriofelis Leidy of earlier date, and Protopsalis Cope of later date turns out to have been founded on a species of the same genus. Wortman remarks of the genus: "The larger species, *P. ferox*, is one of the largest Credonts known, and equalled in size a full-grown black bear. The head was disproportionately large and massive, almost equalling in this respect an adult lion. The smaller species, *P. ulta* Leidy, was almost one-third smaller. In both there were a long and powerful tail, and broad plantigrade feet, which, together with other characters presently to be considered, lead to the conclusion that they were aquatic in habit."

As regards the systematic position of Patriofelis, Wortman says: "Its general skeletal structure is so much like Oxyæna, that notwithstanding the differences in the teeth they must be placed in the same family. Oxyæna is the older form and has the more primitive dentition but the differences are not greater than we would lead to anticipate in the ancestral genus. I think that it can be accepted as demonstrated that Patriofelis is the direct descendent of Oxyæna, which may likewise have given off a branch which terminated in the modern seals. It is somewhat doubtful whether this branch leads through Patriofelis." Concerning the habits of the Patriofelis, Wortman remarks: "From the structure of the limbs more than any other feature, I am led to conclude that it was aquatic or semiaquatic in its habits. The broad, flat plantigrade feet with their spreading toes suggest at the first glance their use for swimming. The eversion of the feet, together with the general clumsiness of the limbs, point, moreover, to the fact that the animal was not an active runner. Now, if the animal was aquatic, what was the nature of its food? It certainly could not have been fish, for the reason that the remains of fishes are very scarce in the Bridger sediments. If, however, we can form any judgment from their remains, the Bridger lake literally swarmed with turtles, and if Patriofelis frequented the water, it is highly probable that they formed a staple article of its diet."

Through the kindness of the American Museum authorities, we are able to give a figure of the restoration of the *P. ferox* (Plate XXXIII) which accompanies Dr. Wortman's article.

Geological News. CENOZOIC—The fossil flora collection from Herendeen Bay, Alaska, embraces 115 forms. These forms, according to Prof. Knowlton, are so closely related to those of Greenland, Spitzbergen and the Island of Sachalin that without doubt they grew under similar conditions and were synchronously deposited. The author agrees with Sir Wm. Dawson in regarding these floras of Eocene age rather that Miocene to which they have hitherto been referred. (Bull. Geol. Soc. Am., Vol. 5, 1893).

Prof. O. C. Marsh has recently given a brief description of a phalange of a large bird which was found in the Eocene of New Jersey. This is an interesting discovery. Unfortunately Prof. Marsh gives it a new specific and even a new generic name. As neither species nor genus can be recognized from a phalange, these names constitute an unnecessary addition to the waste basket of scientific literature.

Prof. Shaler offers additional evidence of orogenic action in producing the folds of the Cretaceous and early Cenozoic beds on the Island of Martha's Vineyard, Mass. As to the origin of those movements, the author inclines to the hypothesis that transfers of sediment tend to excite mountain building action. The exposures at Gay Head and elsewhere show that a great mass of sediment accumulated in that area in a brief period, and the orogenic movements of southeastern Massachusetts occurred shortly after this importation of detritus. (Bull. Geol. Soc. Amer., Vol. 5, 1894).

The record of striæ made by Mr. Tyrrell, during his exploration of N. W. Canada and Hudson Bay, shows that one of the great gathering grounds for the snow of the Glacial period in North America was a comparatively short distance west of the northern portion of Hudson Bay, and that from that centre the ice flowed not only towards the Arctic Ocean and Hudson Bay, but it extended a long distance westward towards the Mackenzie River, and southward towards the great plains, while Hudson Bay was probably open water. (Geol. Mag., Sept., 1894).

BOTANY.[1]

Dr. Kuntze's "Nomenclatur-Studien."[2]—Dr. Kuntze's latest contribution to the nomenclature problem is in the form of a reply to certain criticisms of Pfitzer upon his alterations of names in the *Orchidaceae*. Pfitzer's criticisms are to be found in Engler's *Jahrbuecher* XIX, 1–28. Kuntze answers him in the Bulletin of the Boissier Herbarium, II, No. 7, issued in July, 1894, in an article entitled *Nomenclatur-Studien*. While this article was provoked by the strictures of Pfitzer and deals principally with the nomenclature of the orchids, it is of especial interest to American botanists on account of some criticisms of two rules adopted in this country.

The first section of the article deals with names applied by Thouars to the orchids, which Pfitzer would reject. Dr. Kuntze discusses the matter thoroughly, although he had already gone over the ground in 1891 (Rev. Gen., II, 645–650), and certainly makes a convincing argument. In the course of his reply to Pfitzer on this point, he is led to restate his position on the question of "species-majority vs. place-priority," and to criticize the rule adopted by American botanists. This is done in the second section.

Section II, entitled "priority in place at all events and Article 55," is one of considerable importance. Dr. Kuntze in his *Codex Emendatus* (Rev. Gen., III, 1, CCCCV) proposes the following additions to article 55 of the Paris Code (I quote from his English text):

"A deviation from strict priority is necessary for genera published on the same day and united afterwards:

(1) "If they got no species at their first publication, the genus name to which in 1753 or afterwards was put the first specific name is legitimate.

(2) "If they got also their first species on the same day, the genus name having received most species on that day must be preferred". . . .

Instead of this criterion of "species-majority," American botanists have taken priority of place in the book in which both names were published. This criterion is undoubtedly simple, easy of application, and one obviating all discussions to which the application of the other might give rise. But Dr. Kuntze proceeds to make some applications

---

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

[2] Read before the Botanical Seminar of the University of Nebraska, Sept. 22, 1894.

of the rule which, as he says, operate as a *reductio ad absurdum.* He makes a list of genera subject to the operation of the rule, taken only from Linne's *Species* of 1753, and including good sized genera only. From this list it appears that the American rule will require the use of *Phaca* instead of *Astragalus*—involving the change of 1300 names—of *Sarothra* for *Hypericum,* and of *Amygdalus* for *Prunus.* In his list, taken only from the 1753 edition of the *Species plantarum,* and not an exhaustive one, the American rule will alter the names of 20 genera and 4600 species. None of these are affected by the species-majority rule; *Phaca,* which appears on page 755 of the *Species* above *Astragalus,* has there but 2 or 3 species, while *Astragalus* has 33. So *Pirus* on page 479 with 4 species, would have to yield to *Sorbus* on page 477 with 2—necessitating a change of 55 species at the present time. Are American botanists prepared to follow this rule consistently?

Section III is entitled "Compulsory Index for Plant-names." Dr. Kuntze points out that the enormous increase in botanical literature (there are 7000 titles a year at the present time), has made it impossible for any one to go over everything page by page as botanists could do formerly, and that what would have been gross carelessness at one time is almost a necessity now. He therefore proposes for discussion an article to the effect that articles, magazines and works, unless they have an index of names, including synonyms, to each volume, shall not be considered. It is certainly desirable that every work be well indexed. A book without an index, especially in these unsettled times when no one knows where anything will be placed to-morrow, is as good as sealed. But we may well doubt whether the corrective proposed is not too severe. Such penalties are not readily enforceable; and in the future, should a reaction set in against the rule, as usually happens with arbitrary rules of the sort, it would result in no little confusion by reason of the scope given for interference with established nomenclature.

The next two sections deal with some rejections of names made by Pfitzer. One point is of interest. Pfitzer in rejecting Kuntze's name *Sirhookera* takes occasion to make fun of it, a sort of objection to which, it must be confessed, too many of Dr. Kuntze's names are liable. Incidentally he compares it to "*Amtsgerichtsrathschultzia.*" Dr. Kuntze, as usual, comes back at him with a long list of such names coined by others, which must stand without doubt. And he points out in addition that Pfitzer retains a number of names with *du, de, O',* and *Van* prefixes, which are not dissimilar to *Sir* in *Sirhookera.* As far as the *validity* of such names goes, Dr. Kuntze is doubtless quite

right. That they are not to be commended and that we have far too many already without any fresh creations of the same sort, is readily apparent from an inspection of the list which he cites in his justification.

Section VI is devoted to a discussion, apropos of certain changes made by Pfitzer, of the "once a synonym always a synonym" rule. This rule is one which commends itself to all who have had anything to do with nomenclature. In their determination to confer upon some one the honor of a genus dedicated to his memory—a doubtful honor since it has been so frightfully abused—botanists have multiplied homonyms in some cases to an incredible extent. The rule seems to have been "if at first you don't succeed," try again indefinitely till you succeed in making the name stick. In Section 9 of the introduction of his *Revisio Generum*, Dr. Kuntze referred to this practice as an "abiding source of danger to botanical nomenclature." And in the same place he gives a list of 150 personal genus names which have been repeated in this manner, two seven times, two six times, and fourteen five times. One of the most confusing results of this species of synonyms is the condition of oscillation in which it often places a name. A recent case may serve as an example. In his monograph of the *Onagrariae* in the *Pflanzenfamilien*, Dr. Raimann in subdividing the genus *Oenothera*, revived Spach's genus *Kneiffia*. This name is one year older than *Kneiffia* of Fries, so that *K. setigera* Fr. must have a new name. But supposing future monographers should differ with Raimann as to the limitation of *Oenothera* and *Kneiffia* Spach should become a synonym once more, then, according to the ordinary rule, we should have to restore *Kneiffia* Fr., and the new name would serve only to swell the crowded ranks of synonyms. In this way the name of a genus of fungi could be kept in a state of oscillation for an indefinite period, depending all the while on the views held by phanerogamists as to the limitations of a genus of flowering plants. This is a state of affairs which mycologists cannot be expected to tolerate, and can result only in disregard on the part of monographers of the rules which permit such things. Many similar cases might be cited. It is apparent, then, that some rule is necessary by which this difficulty of genus-names in a state of indefinite suspension can be obviated. The plan which at once suggests itself is to invalidate all subsequent homonyms, so that after a name has been once used it cannot be applied to another group. This is done by the "once a synonym, always a synonym" rule.

But Dr. Kuntze, while recognizing the necessity of some such rule, points out that if given retroactive force, the rule in question will involve us in no little difficulty. He gives a list of 200 generic names, all personal names, which must be rejected under the rule, and states that an exhaustive list would include from 500 to 600 generic names and involve about 7000 species. To this formidable number, should be added a large number of species which will be affected by the application of the rule to specific names. Not only is the rule open to this objection, but Dr. Kuntze makes the further point that, like all retrospective legislation, it does great injustice to past workers who knew no such rule. He, therefore, objects strenuously to any retroactive application of it. But, on the other hand, he recognizes the necessity of making provision for cases like the one detailed above, and he has a suggestion which is well worth considering. In his *Codex Emendatus* (Rev. Gen. III, 1, CCCXIII), he proposes the following addition to Article 60 (I quote from his English text): "Existing homonyms invalidate such homonyms as are in future competitory, or newly established, or renewed." That is, he proposes that the rule be applied to all future cases, and that a name valid now shall not in the future be superseded by any revived homonym. That would obviate the difficulty suggested in regard to *Kneiffia* above, and would certainly accomplish all of what is intended by the American rule, without necessitating so many alterations. Dr. Kuntze points out in the present article the impossibility of any permanent nomenclature in large genera without some rule against the revival of homonyms. As an instance he mentions the genus *Panicum.* He says that in working over the species of this genus in his collections "when I found an older name for a species, there were generally also homonyms of other species forthcoming; about which, however, one did not know whether they were valid or not." The only solution of this is a rule which makes a synonym once a synonym for all time. Whether this rule should be made retroactive, or should be applied only to future cases, i. e. to prevent the renewal of existing homonyms and the creation of new ones, is a question which must be decided by those who, from their investigation of the matter, are competent to pass upon it. Dr. Kuntze's suggestion seems to be a wise one and seems to cover all that is required.

The remainder of the article is taken up with the nomenclature of the orchids, and a concluding section relating to a future congress.

Dr. Kuntze has been subjected to a great deal of criticism, some of it unnecessarily severe, though his controversial methods are not always

calculated to placate his opponents. But whatever may be thought of some of his suggestions, we can have little sympathy with those who, as Pfitzer seems inclined to do, charge him with wanton alterations or selfish motives. On the contrary, there is every reason to accept his statement that he was led into the work of reforming nomenclature in the course of the investigation of his collections, a natural thing when dealing with plants collected in every quarter of the globe, which would bring out the defects of our present nomenclature in a most striking manner. After all his work has but served to bring vividly before us what all were dimly conscious of before. Every man for himself was the principal rule of nomenclature in practice. We must at least admire Dr. Kuntze's persistence in endeavoring to bring about uniformity and a better state of things.

ROSCOE POUND.

Notes on the Trees of Northern Nebraska.—These notes apply to the region embraced in Antelope, Holt, Boyd, Rock, Brown, Keya Paha, Cherry, Sheridan, Dawes, and Sioux Counties. In the last three my observations have been much more limited, and, I doubt not, need extension and revision. They are simply good as far as they go.

The country is composed of sandhills interspersed with small lakes, ponds and streams, hay-flats in the moister valleys, and dry valleys between the rows of sandhills, with stretches of dry, firm table-lands, usually abruptly separated from the sandhill portions by a deep cañon stream. With few exceptions, the trees are confined to these cañons, which branch out into the hill-sides in long reaches, some dry, others worn by unfailing spring brooks or "creeks," as they are generally called.

There is good reason to believe that this treeless region was not always thus. On the tops of some of the sandhills have been found decaying trunks of Pine and Red Cedar buried deep in sand, bearing witness to a different condition of moisture in years gone by. In common with most observers, I think, I attribute the change to the destructive prairie fires that have swept over this region from time immemorial. They form one of the chief obstacles, to-day, to the regeneration of the land. The deep cañons are lined, when dry, from summit to base, with *Pinus ponderosa scopulorum* Engelm. A few scattering specimens are found extending several hundred feet upon the neighboring table. When the base of the cañon is wet, the Pine is found only above the line of moisture. It plants its feet in the gray magnesian,

and soft limestone and sandstone rocks, and in the driest season never seems to lack moisture. It belongs to the foothills of the Rocky Mountains, but extends eastward as far as the west line of Holt County in the Niobrara Cañon. The coincidence, at this point, of the Black Walnut (*Juglans nigra* L.) with the Bull Pine is remarkable. In the cañon at Long Pine are many flourishing specimens, young and old, one with the diameter of three feet. The young ones prove that it sometimes fruits, in spite of the late spring frosts. Its western limit is nearly coincident with Brown County and the 100th meridian.

A large block of Black Walnut was found in Cherry County five years ago, not far from Fort Niobrara, and was preserved by Surgeon Wilcox, showing that it once extended further west. This region furnishes but one oak (*Quercus macrocarpa* Michx.), which grows to a large size. It takes the moist and the dry portions of the cañons about equally, where the soil is at all loamy, leaving the most barren parts to the Pine. Its western limit is about the mouth of Snake Creek, Cherry County, about ten miles west of Valentine.

A rare and notable tree is the Canoe Birch (*Betula papyrifera* Marsh), which flourishes only where a dark and sheltered spot is furnished by a steep declivity with a northern exposure. At Fort Niobrara, where these conditions occur in their perfection, surrounded by rare plants such as *Lonicera hirsuta, Circaea lutetiana, Osmorrhiza claytoni, Carex eburnea,* the two latter not having been found elsewhere in Nebraska. You may see noble specimens of this Birch thirty inches in diameter. It is reported sixty miles west and further east on the Niobrara.

The region affords no more useful and hardy tree than the Ash, of which we have two species:—the common species from Antelope County west to Brown is *Fraxinus lanceolata* Borck., from Brown Co. west to the Hills, *Fraxinus pennsylvanica* Marsh. It is not always easy to distinguish them, as Gray gives a pubescent form of the Green Ash. It occupies the same soil as the Oak, running from the water's edge over the cañon line upon the prairie, where it has been fortunate enough to escape destruction from fire. We have no tree more capable of enduring the rigors of drouth, heat and cold. It seldom attains a size of over thirty inches in diameter.

The Basswood (*Tilia americana* L.) is found along the Niobrara in Brown County, and probably further east; apparently reaching its western limit in Cherry County, about four miles west of Valentine. It affects the borders of streams.

I can find but one elm (*Ulmus americana* L.), though *Ulmus fulva* Michx. has been reported from Long Pine Cañon. This elm is one of the best trees for the region, not only flourishing on the water line, but capable of growing on the uplands almost as well, if protected from fire. It attains a diameter of about four feet, and is universal. The Hackberry is found with it (*Celtis occidentalis* L.), but is much less common and only half the size.

The largest tree of the region is the Cottonwood (*Populus monilifera* Ait.), one specimen in Hat Creek Basin, Sioux County, having a diameter of over five feet. This species is common everywhere along streams, and quickly establishes itself in low meadows by means of its tufted seeds, if not destroyed by fire or mowing-machine. In Dawes and Sioux Counties, *Populus angustifolia* James is found in similar situations. One or two others have been reported.

The only tree willow of the region is *Salix amygdaloides* Anders. I long supposed that *Salix nigra* was common throughout the State, but can find no trace of it here. This tree hangs over the streams, reaching a foot or more in diameter. In this connection it is desirable for me to state that since writing on the shrubs of this region (September NATURALIST, p. 803), in which I mentioned a large willow of the *Cordata angustata* variety, at Ewing, Holt County, I measured the "shrub" in question, and found it twenty-eight inches in circumference, and eighteen feet high, several similar trees growing in the one clump from one root. I think we may say that it has reached "tree-like proportions," though retaining the habit of the shrub.

—J. M. BATES.

Valentine, Nebraska.

Messrs. Rand and Redfield on Nomenclature.[3]—A new contribution to the nomenclature problem has recently appeared in the form of a protest against the Rochester Rules in the Introduction to Rand & Redfield's "Flora of Mount Desert." Although the phases of the question there discussed are by this time rather hackneyed, the tone of the article is so confident, and some of its positions are so amazing, that a few remarks thereon may not be amiss.

Had the authors contented themselves with stating that they adopted the nomenclature of Gray's Manual because most of those who would have occasion to use their book would be likely to use it in connection with the Manual, nothing could be said. Such a course has much to be said in its favor. But they have thought best to strengthen their con-

---

[3] Read before the Botanical Seminar of the University of Nebraska, Nov. 3, 1894.

clusion by an attack upon the Rochester Rules, upon the principles upon which they suppose them to be based, and upon their framers. In the course of this they display a most wonderful ignorance of the whole subject.

In the first place they assume that there was, up to the time the Rochester Rules were framed, a generally received nomenclature, and that the rules in question have overturned it—or have attempted to overturn it. To use their own language, they state that the Rochester Rules are intended to "upset important results of nomenclature evolution for a century and a half." The notion that there has been any fixed or well-defined set of rules "generally followed," or any "generally received" nomenclature, is mostly confined to those whose acqaintance with botanical literature begins and ends with Gray's Manual. To others it has long been apparent that the only generally received. principle was, for the monographers, everyone for himself, and, for the rest of the world, follow the latest monographer. It was to put an end to this, for America at least, and to establish a nomenclature which might have some chance of becoming generally received, and which the next editions of our manuals could not overthrow at the caprice of their authors or editors, that the Rochester Rules were framed.

I have said that the notion that there was a "generally received" nomenclature, was confined mostly to the readers of Gray's Manual. But an examination of that work will speedily show that even the illustrious author of the Manual was far from being sure of "where he was at" in nomenclature.

In the preface to the last edition of the Manual, the editor states that the nomenclature there used conforms to the latest views of Dr. Gray. A comparison with the nomenclature of the preceding editions is, therefore, interesting. One of the first things that one notices is that many changes in the nomenclature of the fifth edition have been made to conform to the "Kew Rule." For instance:

In the fifth edition we find: *Chiogenes hispidula* Torr., *Ilysanthes gratioloides* Benth., *Xerophyllum asphodeloides* Nutt., *Bouteloua curtipendula* Gray. These specific names represent in each case the oldest name: *Vaccinium hispidulum* L., *Capraria gratioloides* L., *Helonias asphodeloides* L., *Chloris curtipendula* Michx. In the sixth edition these appear as *Chiogenes serpyllifolia* Salisb., *Ilysanthes riparia* Raf., *Xerophyllum setifolium* Michx., *Bouteloua racemosa* Lag., the names allowable under the Kew Rule. In the 1848 edition also, we find *Bouteloua racemosa.* That is, in 1848, Dr. Gray followed the Kew Rule in this particular instance, while disregarding it in the other cases mentioned.

In 1868, he thought otherwise as to this one name and used the oldest specific name, while adhering to the Kew Rule in many cases (e. g., *Lophantus anisatus* Benth. = *Hyssopus anisatus* Nutt., 1818, = *Stachys foeniculа* Pursh, 1814). In 1889, his editor, representing "his known and expressed views," changed about as to all of the names in the list just given, and altered a large number of names to conform to the Kew Rule, still, however, disregarding it in some cases. At the same time the editor stated that "reasonable regard" had been had to the claims of priority! This last promise was fulfilled by changing about a dozen specific names and two or three generic names so as to use prior names. For instance, in the fifth edition we find *Nelumbium* Juss. In the last edition, *Nelumbo* Tourn. The name which the Rochester Rules would require is *Nelumbo* Adans. If the editor was willing to alter the name to which Dr. Gray had given currency for thirty years, and to go back to Tournefort for a name, others can scarcely be blamed for following his example in similar cases, and going back at least to the time of Linné. A long list might be made showing the wholly arbitrary and personal character of the alterations made in the nomenclature of the successive editions of the Manual. It is needless, however, since the facts are generally known. No reproach is implied in this so far as the illustrious author of the Manual is concerned, for he only did as all others were doing—namely, followed his personal inclination at the moment in each specific case. But such a condition was a reproach to botanical nomenclature, and could only result in a revolution.

While American botany was in its infancy, it was natural that all should follow blindly in the wake of one great man. It is no less natural that the botanists of to-day should demand something more than a great name to justify uncertainty and vacillation in nomenclature. It is, in reality, the so-called conservatives who stand for disorder and confusion in nomenclature. *They* are the "Rip Van Winkles just awakened from a comfortable nap of years," and somewhat rudely awakened, too, thanks to Dr. Kuntze, and not over-clear in consequence as to who or where they are.

It takes but a moment's glance at the successive editions of the Manual to show how utterly baseless is the notion that the framers of the Rochester Rules are seeking to overthrow "well-established principles of property rights, custom, usage, and the well-established maxim, *quieta non movere.*" The greater part of the rules adopted at Rochester were rules which botanists had, for many years, at least professed to recognize. The fact that the only representative body of American botanists was compelled to legislate on the subject shows of itself that

the state of nomenclature was far from quiet. Anyone who thinks that all was peaceable and serene till Dr. Kuntze and the Rochester Rules came down upon the fold, should be somewhat cautious in his references to Rip Van Winkle. When the most conservative of authors fails to reveal any system or principle consistently followed out in the several editions of his widest known work, and when contemporary works are in hopeless disagreement with themselves and with the Manual, it sounds somewhat strangely to be told that we are cutting "the solid ground from beneath our feet" in laying down a set of rules and principles and agreeing to abide by them. When everybody made changes in nomenclature to suit his personal fancy, no one made any remonstrance, and we all followed the changes of the latest monographer without hesitation. It is only since this state of affairs has become intolerable to the majority of American botanists, and they have resolved to make changes in nomenclature according to rule and principle, and not according to personal taste and caprice, that any complaint has been heard.

The authors also protest against the representative character of the members of the Rochester and Madison meetings, and refer to them as "comparatively few botanists of various degrees of repute." Whether this means that Boston still thinks herself the centre and focus of American learning in all branches, and that the authors regard all of those poor mortals who do not live in the shadow of Cambridge as intruders, or whether it is only another instance of Rip Van Winkle, one need not enquire. The remarks of the authors remind one of some editorial sayings in Zoe *apropos* of the Madison Congress and of the American Botanical Society. The botanists who dissent from the principles of the Rochester Rules certainly have not made much "noise," and the world at large is likely to be glad to know who they are. It will also be glad to know who those botanists are who possess "that added grasp of affairs" which, we are told, in addition to mere knowledge of herbaria and of the literature of the subject, is necessary to qualify a botanist and make him competent to pass on questions of nomenclature. The statements as to the *personnel* of the Rochester meeting fall little short of impertinence.—ROSCOE POUND.

Botanical News.—The University of Chicago announces botanical lectures and laboratory work by Dr. John M. Coulter, who is styled the Professorial Lecturer on Botany. This would seem to indicate that eventually this great University may call Dr. Coulter to build up a department of botany commensurate with its importance.

In September the National Herbarium in Washington was transferred from the Agricultural Building to fire-proof rooms in the eastern pavilion of the National Museum. It will still be under the control and care of Chief Botanist Coville and his corps of assistants.

Parts I and II of the "Flora of Nebraska" by the Botanical Seminae of the University of Nebraska have been published. They aggregate seventy-eight pages of descriptive text and thirty-six plates, and include the Schizophyceæ, Chlorophyceæ, Coleochætaceæ, Rhodophyceæ and Charophyceæ.

The Proceedings of the Madison Botanical Congress have been issued by the Secretary, Dr. J. C. Arthur, of Lafayette, Indiana, in a neatly printed pamphlet of sixty pages.

ZOOLOGY.

Terminology of the Nerve Cell.—Fish attempts[1] to avoid some of the confused terminology of Neurology by proposing a consistent nomenclature, adopting to some extent existing terms. Thus he would call the entire nerve cell, with its appendages, neurocyte; the axis cylinder prolongation; neurite; the other processes dendrites, and the neuroglia cell, spongiocyte. Nerve cells would then be dendritic or adendritic, mono-or dineuritic, etc., according to the number and character of the processes concerned.

Structure of Clepsine.—Oka has attempted[2] the solution of some of the problems of Hirudinean anatomy. After some remarks on external morphology, he takes up in succession the body cavity, blood vessels, nephridia and the systematic position of these animals. The text is rendered much more easy of comprehension from the reconstructions on the plates. Oka recognizes in the lacunæ of the body the true cœlom which is broken up into a large number of anastomosing cavities, in which may be recognized the following principal regions: in the middle of the body, a median dorsal and a median ventral lacuna, in each of which run blood vessels. In front and behind these fuse into a " median " lacuna. These lacunæ are connected by short canals with a complicated " zwischenlacuna," which runs the length of the body on either side, and this in turn by segmentally arranged tubes with a lateral lacuna on either side. These various spaces are also connected with a subepidermal system of lacunæ, the principal canals of which correspond to the annuli of the external surface. In the blood vascular system, which is cut off completely from the lacunar cavities, segmentation has largely disappeared. In but few regions can even the most remote resemblance to a segmental arrangement of vessels be traced, although the dorsal vessel shows segmental enlargements. The nephridia are described at length, the account confirming and supplementing the descriptions of Whitman, Bourne and others, and disagreeing *in toto* with those of Bolsius, except in that they confirm the latter in the description of an ectodermal terminal portion.

In conclusion, Oka thinks the Hirudinei nearest the Oligochætes, basing this view upon chiefly three factors: (1) the existence of a seg-

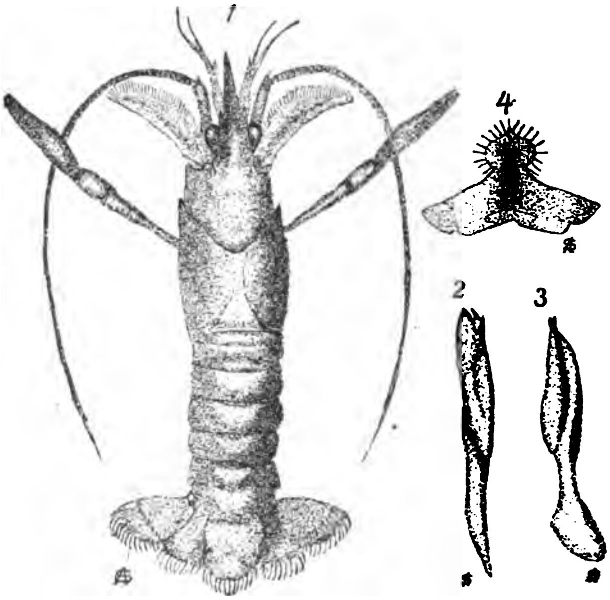
---

[1] Jour. Comp. Neurology, iv, 1894.

[2] Zeitschr. wiss. Zool., lviii, 1894.

mented cœlom; (2) a blood vascular system distinct from the cœlom and (3) a pair of nephridia in each somite; points which it seems to the present writer, imply only Annelid affinities since they fit Polychætes as well as Oligochætes.

A new Cambarus from Arkansas.—*Cambarus faxonii* sp. nov. Male, form 1, rostrum broad, elongate, deeply excavated above, margins raised into sharp parallel ridges, each ending in prominent spines Acumen very long and slender, curved upwards; post orbital ridges prominent, each ending in a prominent spine.



Carapax cylindrical, slightly compressed, smooth; cervical groove moderate, a prominent spine on each side. Distance from cervical groove to posterior margin of carapax 2½ to 3 in distance from cervical group to tip of acumen, and equal to length of acumen. Anterior 1–2 of the areola narrow, its posterior portion triangular. Abdomen broad and slightly shorter than cephalothorax (including acumen). Outer posterior part of telson ending in a prominent spine inside of which is a much smaller spine, posterior margin of telson slightly emarginate. Anterior process of epistoma triangular. Basal segments of antennules with a spine on under inner border, about middle of segment. Antennæ shorter than the body, antennal scale long and narrow (i

length almost three times its greatest width), slightly curved outward and ending in a sharp spine, equals the rostrum.

Basal segment of antennal scale with a prominent spines on anterior lateral borders. Chelipeds slender, not tuberculated, slightly hairy; fingers shorter than hand, opposed margins of the fingers straight, hand smooth; carpus smooth; a spine on inner and outer distal borders. Meros smooth with one spine on upper and one on outer side, and two below, all spines on distal 1–3. Third pair of legs hooked, fifth pair with a small roundish tubercle on basal joint.

Anterior abdominal appendages strong and of moderate length, tips reaching between third pairs of legs, bifid at apex, apex of inner part posterior and acute, its tip turned slightly outward, outer bluntish.

Color of this species somewhat mottled with bluish on antennal scale and rostrum, forming cross bars.

This is apparently a small species. The largest specimens taken were females, length (from tip of acumen to posterior margin of telson) of largest specimens, 2½ inches. The size of average males, 2¼ inches.

This species is easily recognized by its long, slender acumen, small hand, slender antennal scale and its small size. Found in St. Francis River at Greenway and Big Bay. It is by no means abundant. This and young of one other species, *C. palmeri*, are all I found in the St. Francis River.

Named in honor of Dr. Walter Facon, to whom we owe more than to anyone else our knowledge of North American crayfishes.

EXPLANATION OF FIGURES.

1. Dorsal view of specimen, x, 1.31.
2. Abdominal appendage, inner view, x, 4.35.
3. Abdominal appendage, posterior view, x, 4.35.
4. Epistoma, x, 4.

The drawings were made by Miss Allie Simonds, Arkansas University, Class 1895.

S. E. MEEK,
Arkansas University,
Oct. 22, 1894, Fayetteville, Ark.

A New Bassalian Type of Crabs.—In a recent number of the Journal of the Asiatic Society of Bengal (v. 63, part 2, No. 3), a most remarkable crab has been described and illustrated by Messrs. A. Alcock and A. R. Anderson. It has been designated (p. 141) as "*Archæ-*

oplax, a Gonoplacid (?) crab of a remarkably antique facies, which appears to be closely connected also with *Cymopolia*."[3]

The description and figures appear to me to indicate that the new crab has no close relationships with either the Gonoplacids or *Cymopolia*.

Through the kindness of Miss Rathbun, of the Invertebrate department of the U. S. National Museum, I have been able to study specimens of all types and compared them with the data respecting *Archæoplax*, and could find no special features of agreement. *Archæoplax*, it seems to me, must be considered entirely independently of the types with which it has been contrasted.

I may preface the further remarks I have to make with the statement that the crab so called by Messrs. Alcock and Anderson cannot retain the name given to it by them—*Archæoplax*—as precisely the same form had been bestowed more than 30 years ago on an extinct genus, also of the superfamily of Grapsoidea, represented by fossils from Gay Head, Mass. *Archæoplax signifera* was the name given by W. Stimpson to miocene tertiary remains found there, and described in the Boston Journal of Nat. Hist. (vol. 7, p. 584, 1863).

As a new name is therefore necessary, I would suggest as eminently appropriate for the crab made known by Messrs. Alcock and Anderson, the generic designation *Retropluma* (*retro*, back or backward, and *pluma*, a soft feather). The applicability will become evident in due course.

When I first saw the figure of the mouth parts I inferred that the external pair of maxillipeds had been lost, but Messrs. Alcock and Anderson expressly declare (p. 182) that "the external maxillipeds are so small and slender as to leave completely exposed the mandibles, the wide endostome, and a part of the wide and produced efferent branchial channels." They give the figures as those of a perfect animal, and apparently had a number of specimens.[4] We are, therefore, placed in the dilemma of assuming that the crab differs radically from all others, or that the learned authors may have been mistaken; I prefer, in this dilemma, to leave the question open for re-examination by the original describers.

The new type, however, differs in another character almost as remarkable as would be such an extreme and anomalous modification of the maxillipeds supposed by its describers.

---

[3] It is later (p. 180) suggested that "its nearer affinities are, perhaps, with the Macrophthalmines."

[4] "Bay of Bengal, at almost all stations off the Coromandel coast, from 140 southwards, between 100 and 250 fms." P. 183.

"The fifth pair of trunk legs is quite unique in form and disposition: they arise quite close to the middle line of the body and high up, almost on the back; they are short, being considerably less than the breadth of the carapace in length, and are very slender and flexible; and they are so thickly fringed with shaggy hairs as to appear like feathers."

This peculiar modification of the last pair of limbs is very unlike that of the corresponding legs in the notopodous or anomurous brachyurans, and indicates that some special function may be assumed. The loss of geniculation and the straightness, the slenderness and flexibility, and the dense hairylike covering must mean something. May it not be that the peculiarly modified limbs have been specialized for purposes of aërification of an increased vascular supply, and that they have become functionalized as branchiæ? Until some better hypothesis can be suggested or tested by histological examination, bold as it may seem, the explanation cannot be considered irrational.

As has been already remarked, *Retropluma* has no close relationship with the forms compared with it or with any other known types. It should, therefore, be regarded as the representative of an independent family—*Retroplumidæ*—especially characterized by the peculiarly modified fifth pair of feet, want of true orbits, and position of the antennæ. For the present it may be retained in the superfamily or tribe *Grapsoidea*, on account of the reduced number of branchiæ ("six on each side") and form of body. If, however, the illustrations and description of the mouth parts are correct, it must be widely removed. The only known species is *Retropluma notopus*.

I cannot appreciate any "remarkably antique facies in the new crab." On the contrary, it appears to be a form excessively modified for deep sea life.—THEO. GILL.

Note on the Occurrence of Hyla andersonii in New Jersey.—About the middle of June, 1889, Mr. Louis M. Glackens and the writer were engaged in general biological studies along the Atsion and Batsto Creeks, in Atlantic and Burlington Counties, New Jersey. On the night of June 17th we stopped at Pleasant Mills. Shortly before sundown a thunder storm arose, just previous to and during which the frogs became very noisy in a swampy thicket near by.

The note was an unfamiliar one and invited investigation, which resulted in the capture of two specimens of this handsome and rare species. The shrill quack-ack, which at the time was compared to the note of a frightened guinea fowl, and which is not unlike the call of a

rail, was constant and seemed to come from every tree; but during our progress through the thicket the voices immediately around us, for a radius of about 25 feet, were silent. This circumstance and the oncoming darkness made it difficult to secure specimens, although the frogs were so abundant. The two secured were found perched on the lower sides of branches of the pines with dilated and vibrating throats, though at the moment they were silent; and it was noted that they emitted an odor which was likened to that of raw green peas. The color above in life was a bright pea green, quite unlike the dull olive green of spirit-preserved specimens. The lateral stripe was of a very rich velvety purple. The following morning we could find no trace of them, but later in the day heard another chorus in the middle of a dense swampy thicket. Since then Mr. H. F. Moore and myself have repeatedly visited the locality in quest of the Hyla and its eggs, but entirely without success. To the natives the frog is unknown.—J. PERCY MOORE.

Yolk Nucleus of Cymatagaster.—J. W. Hubbard, in a paper,[5] the proof-reading of which could be better, shows that the yolk nucleus in these fish eggs is produced from the true nucleus, soon after the cell becomes differentiated as an egg, that it migrates towards the vegetative pole, and after the closure of the blastopore, it breaks up and disappears in the yolk. He claims that the same structure occurs in many eggs and has been mistaken for the spermatozoon, and thinks it homologous with the meganucleus of the Protozoa, a conclusion which needs more support than is advanced in the paper. The review of the literature omits several important papers.

Zoological News. PROTOZOA.—Gruber, in his Amöben-Studien,[6] comments on the great rarity of observations on the division of the Amœba, and especially calls attention to the absence of any observations upon the mitotic division of the nucleus. He calls upon other observers to make observations on this point. He has had an opportunity of directly comparing Rhizopods from Massachusetts and from the Black Forest, and says that the forms from the two localities are identical. Some remarks are made upon specific characters in the Rhizopods.

CŒLENTERATA.—Grieg, in a paper but recently received,[7] catalogues 30 species of Pennatulida as belonging to the Norwegian fauna.

[5] Proc. Am. Philos. Soc., xxxiii, 1894.

[6] Bericht Naturf. Gesellsch., Freiburg, viii, 1894.

[7] Bergens Museums Aarsberetung for 1891, 1892.

Apellöf, in the same volume, describes several structures in the anatomy of Edwardsia. Among the points brought out are the presence of a nervous system in the capitulum, the absence of siphonoghyphes, of septal stomata, of acontia. Its nearest affinities appear to be with Protanthea of Carlgren (1891).

WORMS.—Stiles calls attention[8] to the discovery in a cat, by H. B. Ward, of *Distoma westermanni*, a fluke new to the U. S. The same species is a common parasite in man in Eastern Asia.

Ward describes[9] *Distoma opacum*, parasitic in *Amia calva*, *Ictalurus punctatus*, and *Perca flavescens*. In its structural characters the species is closest to *D. pygmæum* of the eider duck. The fish become infested by feeding upon crayfish (*Cambarus propinquus*), in which the parasite was found encysted.

CRUSTACEA.—Miss Mary J. Rathbun describes[10] four new species of crabs from the Antillean region and gives[11] a series of notes upon the species of Inachidæ in the National Museum. There seems to be a tendency in these and other papers to differentiate genera and species on too minute and too variable characters, which, we hope, will not be continued in the promised Synopsis of North American Crustacea.

ARACHINDA.—Purcell's complete paper on the eyes of harvestmen has appeared,[12] and the illustrations make clear the difficulties of his previous paper, already noticed (this volume, p. 345).

Bernard[13] calls attention to the fact that the Galeodidæ, instead of lacking lateral eyes, have these organs transferred to the lateral surface, where they look downwards and forwards. Bernard thinks these organs are in process of atrophy, although one would not draw such conclusions from the rough figure of a section which he gives.

Simmons describes[14] the development of the lungs and tracheæ in spiders. The lungs develop on the posterior surface of the anterior abdominal appendages, and the appendages, sinking in form the anterior wall of the pulmonary sac. The tracheæ in their earlier stages are like the lungs, and later begin to penetrate the body. "From this it follows that the lung-book condition is the primitive one, the

---

[8] Johns Hopkins Hospital Bulletin, No. 40, 1894.

[9] Proc. Am. Soc. Microscopists, xv, 1894.

[10] Proc. U. S. Nat. Mus., xvii, p. 83, 1894.

[11] Tom. Cit., p. 43.

[12] Zeitschr. Wiss. Zool., lviii, 1894.

[13] Ann. and Mag. Nat. Hist., xiii, 517, 1894.

[14] Am. Jour. Sci., xlviii, 1894. Tuft's College Studies, No. 2.

tracheæ of the Arachnids being derived from it. And with these facts these is left no ground for those who regard the 'Tracheata' as a natural group of the animal kingdom."

HEXAPODA.—Schott has a monograph of palæarctic Thysanures in Vol. xxv of the Handlingar of the Swedish Academy, 133 species and varieties are enumerated, of which 9 are new. Seven plates illustrate the article, which cannot be neglected by entomologists.

A most interesting paper on the relations between attitude and color of European butterflies is given by Dr. Standfuss in the Zürich Society's Vierteljahrschrift for 1894.

HEXAPODA.—Scudder gives[15] a synopsis of the ringless locustarians of the tribe Ceuthophili. Six genera and 67 species are described.

MOLLUSCA.—Dall has monographed[16] the genus Gnathodon. From a consideration of large suites of specimens, and of young as well as old, and also from a study of the soft parts, he concludes that the genus is distinctly Mactroid in character. Ten species and varieties are enumerated.

Dr. Stearns[17] catalogues, with notes, a collection of shells from Lower California and adjacent waters, made by W. J. Fisher in 1876, together with those of other collectors. The paper has great value in matters of synonymy and geographical limits of species.

Apellöff records[18] the presence of several North American species of Cephalopods on the Norwegian coasts, and describes an example of *Eledone cirrhosa* in which the third right arm of both sides is hecotocotylized.

FISHES.—Gill shows[19] that our American pike perches must continue to bear the generic name Stizostedion, and that the European *Lucioperca marina* has more affinities with the other European species than with any American forms.

The same author also pleads[20] for the use of Pœciliidæ instead of Cyprinodontidæ, and discusses the nomenclature of the Lampreys, discarding his previously advanced name of Ammocœtes for the genus Lampetra. He further makes a family Mordaciidæ for the genus

[15] Proc. Amer. Acad. Arts and Sciences, xxx, 1894.

[16] Proc. U. S. Nat. Mus., xvii, 1894.

[17] Tom. Cit., 1894.

[18] Bergens Museums Aarbog for 1892, 1893.

[19] Proc. U. S. Nat. Mus., xvii, 1894.

[20] L. c.

Mordacia. In a fourth paper he discusses the subdivisions and relationships of the Salmonidæ and Thymallidæ.

E. D. Cope catalogues[21] a collection of 42 Fishes from the Rio Grande do Sul, Brazil, Of these, 17 are new. The species of Characinidæ and Siluridæ, 15 and 14 respectively, predominate.

BATRACHIA.—Miss Platt has published[22] her complete paper on the origin of the cartilaginous structures in the head of Nicturus, to which reference was made on p. 637 of the present volume.

Peter has studied[23] the vertebræ of the Cæcilians, and concludes that the evidence from these structures justifies the view of Wiedersheim (1879) and Cope (1884) that these forms should be assigned to Urodela. Regarding Cope's view, adopted by the Sarasins, that in Amphiuma we must recognize the ancestral form of the Cæcilians, Peter says, "there is indeed a certain similarity in the vertebræ of Apoda and Amphiumidæ, but no greater than exists between them and Siren, so that the view of this student is supported chiefly by developmental conditions."

MAMMALS.—Dr. E. A. Mearns describes[24] as new, *Sigmodon minima,* from New Nexico.

Dr. J. A. Allen points out[25] that the skull in Neotoma is extremely variable, and that "species" founded on certain cranial characters are frequently not of varietal rank.

---

[21] Proc. Am. Philos. Soc., xxxiii, 1894.

[22] Archiv für mikros. Anat., xliii, p. 911, 1894.

[23] Karl Peter. Die Wirbelsäule der Gymnophionen. Dissertation. Freiburg, 1894.

[24] Proc. U. S. Nat. Mus., xvii, 1894.

[25] Bulletin Amer. Mus. Nat. Hist., vi, 1894.

ENTOMOLOGY.[1]

Some Observations on the Distribution of Coccidæ.[2]—Being now in the midst of preparing a new list of the known Coccidæ, with notes as to food-plants, distribution, etc., I have thought it opportune to submit to you a few observations which seem to me to be of interest, relating to the geographical distribution of the several genera. In preparing these notes, I have, moreover, been moved by a lively hope that some of you who have so much unpublished information regarding this group of insects, may be induced to throw a little fresh light on points which are now obscure. More especially do I refer to the numerous undescribed species which must doubtless exist in the collections at Washington, information of which would so greatly help to fill up blanks now too apparent to those who read our lists with a critical eye.

The following genera, some of them not very well established, are monotypic according to present information.

Walkeriana Sign.; Ceylon.
Guerinia Sign.; Mediterranean Region.
Tessarobelus Montr.; New Caledonia.
Drosicha Walk.; Ceylon and China.
Llaveia Sign.; Mexico.
Nidularia Targ.; Europe.
Capulinia Sign.; Mexico.
Cerococcus Comst.; Arizona, California.
Xylococcus Löw; Austria.
Callipappus Guèr.; Australia.
Rhizœcus Künck., in hort (from Australia?).
Puto Sign.; Europe.
Tetrura Licht.; Europe.
Cryptococcus Dougl.; Europe.
Signoretia Targ.; Europe and Australia.
Fillippia Targ.; Europe.
Pseudopulvinaria Atkins.; Sikkim.
Vinsonia Sign.; West Indies, etc.
Physokermes Targ.; Europe.
Aclerda Sign.; France.

---

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Read before the Entomological Society of Washington, Oct. 11, 1894.

Spermococcus Giard.; France.
Excærctopus Newst.; Channel Is.
Ericerus Guèr.; China.
Fairmairia Sign.; France.
Ischnaspis Dougl.; West Indies, etc.
Frenchia Mask.; Australia.

Of the above twenty-six monotypic genera, most of which are undoubtedly valid (seven, perhaps, might be questioned), it will be seen that just half are European, four are Oriental, four appear to belong to the Australian region, two are Mexican, two are marked as from the West Indies, etc., and one is from the arid portion of the United States.

Signoretia offers a singular case, the European species being represented in Australia by a form which Maskell separates from it only as a variety. Supposed endemic species of *Signoretia* from Australia and New Mexico prove to belong to *Pulvinaria* and *Bergrothia* respectively; and it is difficult to avoid the conclusion that *S. luzulæ* var. *australis* Maskell, from Australia, must be *S. luzulæ* which has been introduced and has varied from the type under its new environment. If so, the matter deserves the close attention of evolutionists.

It is curious that the common *Physokermes* of Europe has no representative here in America. We have two species of *Lecanium* on conifers, one in Canada, the other in California, but they are not like *Physokermes.*

So, also, we seem to have no representative of the subterranean European genera, *Aclerda, Spermococcus* and *Excærctopus.* Do our ants' nests never harbor such?

Fairmairia has a close ally in northern Mexico and New Mexico in *Ceroplastodes*—the latter with two species. A curiously similar case is offered by *Lichtensia,* which has one species in Europe and another in Vera Cruz, Mexico. The latter, one of the most beautiful of Coccidæ, from its brilliant yellow color, cannot be made the type of a distinct genus, though it is very different from its European congener.

Vinsonia and *Ischnaspis* (the latter near to *Fiorinia*) are common on cultivated plants in the West Indies, but the specimens offer no chance for the separation of even varieties. *Ischnaspis,* it will be noted, is the only monotypic genus of Diaspinæ.

The Monophlebinæ appear to be ancient forms, probably at one time more abundant than now. They have been found fossil both in Europe and America; and the existing genera are represented by comparatively few species widely scattered over the earth, after the

manner of *Peripatus*. Thus, *Palæococcus*, to which the fossil species are assigned, has three living species, one in Europe, one in South America and one in New Zealand.

Ortonia has also three species; one from Natal, the other two neotropical.

Icerya appears to be neotropical, Oriental and Australian; and there is an allied genus or subgenus, which I hope Prof. Riley will soon describe, found here in New Mexico.

Porphyrophora is considered Palæarctic, but has its representative in America in *Margarodes*, with one West Indian and one Chilian species. *Cœlostoma* is confined to Australia and New Zealand, and thus forms an exception among the polytypic monophlebid genera; but *Monophlebus* is recorded from widely separated countries in the Eastern Hemisphere.

Gossyparia has five species, two Palæarctic, two Australian and one from New Zealand—truly a curious distribution!

Eriococcus is interesting. Six species are Palæarctic; Australia and New Zealand together have no less than sixteen, only one of which is common to both these countries, and then the Australian form is a distinct variety of a New Zealand species. No other species whatever are known except three from North America, two of which, *E. azaleæ* and *E. coccineus*, cannot well be native there. In the West Indies, where *Dactylopius* abounds, no *Eriococcus* has been ever seen.

Rhizococcus presents one Palæarctic species, three from Australia and six from New Zealand. We seem to have in this country two undescribed species, however.

Bergrothia, which is very near to *Dactylopius*, has one Palæarctic species; while two very nearly allied forms are found in New Mexico, and referred by me to the same genus. Still another is reported from Indiana, etc., but is undescribed.

Dactylopius seems to be rich in species in most parts of the world, but becomes rare and is supplanted by *Phenacoccus* in the northern parts of the Palæarctic region, such as England. The neotropical species are numerous, but the nearctic forms are singularly few, and (excepting introduced ones) all western. Mr. Coquillett has described them, and I have sent the description of a fourth to the printer. There are nine known species from Australia and eight from New Zealand; for the most part these differ in type from the neotropical forms, so that it might be proposed to place them in a distinct subgenus. The genus *Dactylopius*, as now understood, contains very divergent forms, but great difficulty is felt in any attempt to separate it into subgeneric groups.

Phenacoccus is rich in Palæarctic species, there being eleven or twelve, several recently (1886–1891) described. In strong contrast, we have but two endemic nearctic species, both western. There is not one from the neotropical region, but Australia furnishes two and New Zealand one.

Ripersia has five Palæarctic species, three from New Zealand and one from Australia. It was thought that we had none in America, but Mr. N. Banks has discovered a most remarkable maritime species, the description of which now awaits publication. It is very closely allied to one (*R. rumicis*) from New Zealand.

Coccus has three races, perhaps not very distinct as species, from the warmer parts of North America, extending northward in the Rocky Mountain Region. *C. agavium* may be referred to a distinct genus, *Gymnococcus* of Douglas, which should be added to the list of monotypic genera above. Its native country is unknown.

Kermes has several Palæarctic species; one Ethiopian, not yet described; one Australian; and a problematical number nearctic. In the last mentioned region only a single species has been described, but others exist and sorely need attention. No species are neotropical.

Orthezia is doubtless an old form, and certainly a very interesting one. The number of Palæarctic species is a matter of dispute, but there are not over half a dozen. Four are nearctic; and here it may be mentioned that Prof. C. H. T. Townsend has just discovered a beautiful new one in Sonora. Two are neotropical, both described by Douglas. None were known from the Oriental region, until the other day Buckton described one from Ceylon. Not one occurs in Australia or New Zealand.

Prosopophora was described as lately as 1892, but already we know four species, one neotropical, one nearctic (New Mexico), and two from Australia.

Tachardia has four American species, one still awaiting publication. There is, also, one from the Oriental region, while three are Australian.

Pulvinaria is rich in Palæarctic species, but the endemic nearctic species are only three or four! Four are neotropical; two (one undescribed) Oriental; four Australian; and one is from the Sandwich Is. The absence of native species in New Zealand is noteworthy.

Ctenochiton, with eleven species, and *Lecanochiton*, with two, are strictly confined to New Zealand; and may be set off against the numerous extraordinary gall-making forms of Australia, which are wanting in the New Zealand fauna.

Inglisia has five New Zealand species, and until last year was supposed to be confined to that island. But in 1893 Mr. Maskell described one from Australia, while this year I have described a species from Trinidad in the neotropical region.

Ceroplastes has its metropolis in the neotropical region, with thirteen supposed species, some of the most doubtful validity. One only is native in the nearctic region, and that to the south (New Mexico and Northern Mexico), as *C. rusci* is in Europe. One is Ethiopian, two Australian, and two Oriental. Of the last mentioned, *C. ceriferus*, which produces the Indian White Wax, appears to be also widely distributed in the neotropical region. Can it be a survival in both regions, like the tapir—though not, like that, differentiated into species?

Lecanium presents nearly 90 species, several of which, however, may not be valid. The *Eulecanium* series is abundant and widely distributed in the Palæarctic and nearctic regions, but I do not know a single *Eulecanium* from elsewhere. In the tropics the *Bernardia* section, with few but very destructive species, takes its place. The neotropical species, when we eliminate those introduced from elsewhere, amount to only eight, only one of which (*begoniæ*) is a *Bernardia*, and the endemic character of that is a matter for serious doubt. But who shall say that *L. oleæ* and *hemisphericum*, which belong to *Bernardia*, are not neotropical, since they are now so widely spread that their native country cannot be learned? The Oriental species, so far as endemic, are but six, while three peculiar forms are recognized as endemic in Australia. In New Zealand, Mr. Maskell has found but one new species, and that is extremely near to *L. oleæ*.

The above notes will suffice for the purpose intended, though many genera, including the Diaspinæ, are passed over. Defective as our knowledge is, we seem to see some glimmering of light, which should spur us on to further discoveries which will give a sound foundation to our knowledge of Coccid distribution.—T. D. A. COCKERELL, New Mex. Agr. Exper. Station.

Securing Moth's Eggs.—J. B. Lembert describes[3] the following method of securing eggs of moths: "When I take an *Arctia ornata* ♀ and she is ready to lay eggs, the moment she shows signs of being stupefied in the cyanide bottle, I take her out, close the wings over her back, and place her in a paper envelope; as soon as she revives she will commence to scratch the paper with her legs; I then shake the envelope, and if she has given up some eggs, I take them out, give her

---

[3] Can. Entomologist, June, 1894.

another dose of cyanide fumes, and when she revives a second time I have found as many as 125 eggs in the paper." The method has also been successfully used in securing the eggs of butterflies.

American Species of Seira.—In a paper on the American species of the Thysanouran genus Seira[4] Prof. F. L. Harvey describes *S. mimica* n. sp., which resembles *S. nigromaculata* Lubbock, but differs in the color and the arrangement of the color patches. It is found in warm, dry situations about buildings. *S. bulkii* Lubbock was also found at Orono, Me., under conditions which indicated that it was indigenous.

Kentucky Orthoptera.—Prof. H. Garman publishes, in the Sixth Annual Report of the Kentucky Agricultural Experiment Station, a valuable list of the Orthoptera of that State. In introductory paragraphs he makes the following remarks which are of general biological interest:

"The fauna of the State presents no well-marked features of its own. The eastern half of the State evidently forms part of an eastern zoological region, while the western half is as evidently southern in general character. The species occurring within our limits fall under five categories, as follows: (1) Those which occur everywhere in the United States, such as *Gryllus abbreviatus*, *Hippiscus rugosus*, *Chortophaga viridifasciata*, *Pezotettix bivittatus*, *P. femurrubrum* and *P. atlanis*. (2) Those which belong to the eastern region, represented by *Acridium alutaceum*, *A. rubiginosum* and *Paroxya atlantica*. (3) Southern species, such as *Schistocerca americana*, *Anisomorpha buprestoides* and *Stagmomantis carolina*. (4) Western species, such as *Pezotettix differentialis* and *Mestobregma cincta*. (5) Cave species, of which we have three.

"In Eastern Kentucky the fauna is, as a whole, eastern and northern in character, rather than southern, probably because of the greater elevation above sea level of this part of the State. The southern species show a marked increase in abundance in this section as one approaches the southern boundary of the State. Here the northern limit of the Austroriparian region may be said to coincide with the boundary between Kentucky and Tennessee, and so continues to the headwaters of the Barren River, where a sharp northward extension occurs, bearing gradually northwestward, and following along the eastern limits of our western coal fields to enter southern Indiana and

---

[4] *Psyche*, Nov., 1894.

Illinois. I could not perceive any very decided southern features of fauna or flora at Campbellsville and Greensburg, near the headwaters of Green River. At Bowling Green and Glasgow Junction the southern character is decided. At Elizabethtown, farther north and east, the fauna and flora do not appear to be very different in relative abundance of species from those of the region about Lexington. The eastern limit of the northward extension of the Austroriparian region would thus appear to follow approximately the meridian marking the 86th degree of longitude west from Greenwich, and accompanies a fall in altitude to about 500 feet above sea level, the blue-grass region to the eastward being in the neighborhood of five hundred feet higher than the region west of Leitchfield. This western region is marked not only by an increased abundance of southern Orthoptera, but quite as decidedly by its other insects, its plants, and its vertebrate animals. Among Lepidoptera, *Callidryas eubule* and *Euthisanotia tamais* become noticeable. The water moccasin (*Ancistrodon piscivorus*) and the shining bass (*Centrarchus macropterus*) appear. There is a decided increase in the numbers of such birds as the tufted titmouse, summer redbird and scarlet tanager.

" We find here the spider-lily (*Hymenocallis occidentalis*), the American aloe (*Agave virginica*), the willow oak (*Quercus phellos*), the water-locust (*Gleditschia aquatica*) and the Mississippi hackberry (*Celtis mississippiensis*).

"Among the Orthoptera found in this end of the State two are worthy of special mention because their occurrence is in some respects exceptional. *Mestobregma cincta* is recorded by collectors from Colorado and Wyoming. Dr. Cyrus Thomas obtained examples from Southern Illinois. I recently collected specimens at Glasgow Junction and Bowling Green in this State. I have no record at hand relating to its occurrence in regions between these widely separated eastern and western habitats. The second species is *Pezotettix differentialis*, the large olive grasshopper so common in the northwest. It appears to be one of a relatively small number of northern species whose distribu-

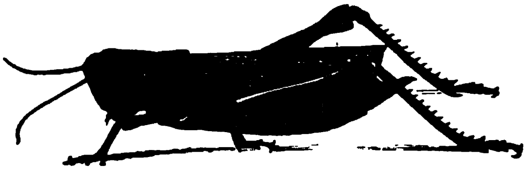


FIG. 1. *Pezotettix differentialis.* After Riley.

tion is extended to the southward by the influence of the Mississippi River. The species is one of the commonest Illinois grasshoppers. It is common locally in Western Kentucky, but has not been seen eastward.

"The peculiar cave Orthoptera of Kentucky are deserving of a word in this connection. The species are all wingless crickets with greatly enlarged hind limbs for leaping, and excessively lengthened antennæ. All have eyes of the usual size, and without exception live by preference near the cave mouths. The species most completely adapted to life in the caves is the cave cricket (*Hadenœcus subterraneus*). It is a large brown creature, so fragile that it is almost impossible to get perfect specimens. Specimens taken alive from the caves in summer, invariably died, probably because of the sudden change of temperature. I am disposed to think they could be removed in cool weather without difficulty. I have never seen this species anywhere but in caves. It occurs in all our larger caverns, however. A second species (*Ceuthophilus stygius*) resembles the preceding in general form, but has the legs and antennæ less lengthened, and is spotted with black. It is closely allied, both in structure and color, with species occurring out of doors under rocks. It is more closely confined to the region near the entrance of caves than is *Hadenœcus subterraneus*, but appears not to leave the caves. These two are the only cave crickets I have seen in Kentucky, but Dr. A. S. Packard, of Brown University, has obtained a third, which he says is associated in caves with the preceding. I have a number of specimens that agree perfectly with his description of this cricket, but they were found in every case under rocks or logs out of doors."

Coleoptera of Lower California.—At a recent meeting of the Cambridge Entomological Club, Dr. G. H. Horn discussed this subject.[5] He remarked "that about 800 species were now known to him from the region which may be divided into four faunal provinces: (1) The San Diego fauna extends down the larger part of the west coast. (2) The fauna of the highlands (so far as collected, *i. e.*, north of the middle of the State) seems to be related to that of the Central California Valley. (3) The fauna of the east coast extends through Arizona northward, and eastward down the Rio Grande. (4) The fauna of the extreme southern end of the peninsula is truly tropical in character."

New Fossil Beetles.—Mr. S. H. Scudder calls attention[6] to a

[5] *Psyche*, Nov., 1894.

[6] *Psyche*, Nov., 1894.

new family of fossil beetles established by Schlechtendahl in a recent paper on the fossil insects of Rott on the Rhine (Abh. Naturf. Ges. Halle, XX). It is named Paleogyrinidæ, and the type shows a combination of the characters of Gyrinidæ and Dytiscidæ. "Extinct types of insects of as high a grade as families are extremely rare in the tertiaries."

Reversal of Position in Insect Embryos.—Dr. G. A. Chapman summarizes[7] his own and others' observations on the phenomena associated with the change of position that occurs in the young lepidopterous larvæ within the shell before hatching. "In all cases the larva first appears on the surface of the yelk-mass as a flat plate, of which the central line is the middle of the ventral surface, and the margins are the two sides of the dorsum, still far apart. These margins, however, rapidly curl in and, at the head and tail, the young embryo soon has the cylindrical form we associate with the larva, but centrally, there remains a wide opening through which the mass of the yelk is continuous with that portion of it contained in a central cavity of the larva; this central cavity is the future alimentary canal, not yet provided, however, with any opening towards either the head or the tail. The communication between the intestinal cavity and the yelk sac gradually becomes smaller, and portions of yelk leave the sac and pass into the intestine, and contribute to the growth of the embryo. During this period, it is easy, in flat eggs like those of the Pyralides, Tortrices, Limacodes, etc., to see the embryo curled around a greater or less portion of the yelk sac, with its ventral surface towards the margin of the egg, and its dorsal surface (aspect rather than surface, as the surface is still broken by the umbilical opening) applied to the yelk sac. There is a little variation in the degree to which the yelk disappears before the umbilical opening closes, but when this takes place the larva forms a horseshoe or circle, with the venter towards the shell wall and its anterior and posterior extremities in contact. At this period, also, there are a varying number of globules of yelk free in the egg cavity around the larva; whether these are set free by the movement of the larva that now takes place, or still later by the jaw action of the larva, I am not sure, but after the movement has taken place the young larva swallows these; this swallowing of the remaining yelk may indeed be regarded as a first step towards eating its way out of the egg. Before the closing of the umbilical opening, the embryo may be regarded as an appendage to the yelk sac, attached thereto by its

---

[7] Entomologist's Record, Oct. 15, 1894.

PLATE XXXIV.

From photograph of Stalactite 60 centimeters long and 20 years old; formed between the years 1873 and 1893 on the ceiling of a reservoir roof arch at Bayreuth, Bavaria. Scale $\frac{1}{7\cdot73}$

dorsal aspect. As soon as the opening closes, however, the young larva is truly a young larva, possessing no organic connection with the other egg structures. The first use it makes of its liberty is to bend the tail forwards and, as it were, creep up its own ventral surface, assuming in this process an S or pot-hook shape, until at length its position is reversed, the dorsum being now along the circumference of the egg and the venter being central. The head and tail sometimes merely meet in the (flattest eggs), sometimes slightly overlap, whilst, in the dome-shaped eggs the head so overlaps as to take very often a central position in the vertex of the egg, forming a dark spot there, as in Acronycta, Skippers, and many others.

"The essential importance of this observation is, that it shows that the embryonic position of the nervous system is the same in insects as in vertebrates, and since it must, therefore, be identified also in the mature animal, it follows that the venter of insects corresponds anatomically with the dorsum of vertebrates, and *vice versa*.

"As regards the actual change of position itself, and the position afterwards taken by the larva, it seems to me that the important point is that the larva whilst still truly an embryo, that is, whilst still attached to the yelk and egg structures, has the venter outwards, and the dorsum towards the center of the yelk or egg; but when it becomes free it is no longer an embryo, it moves how it likes, and through the position it takes up seems to be very uniform throughout each species and and even throughout whole families; still this has little, if any, embryological significance. I have frequently seen larvæ making this S movement, and though I have called it 'creeping up its own ventral surface,' it goes on slowly, without any apparent voluntary or even movements, and appears to be due to the mere force of the growth and development of the larva. Sometimes it seems as if the lengthening of the larva led to the extremity of the tail impinging against the side of the egg-shell and instead of sliding onwards, being caught and bent up. It is associated no doubt with the completion of the growth of the dorsal surface previously defective by the large umbilical opening, and now more abundant in proportion to the ventral surface. It proceeds slowly and steadily, so that usually some progress may be noted in five or ten minutes.

"Very shortly after, what appear to be voluntary movements of swallowing take place, the remainder of the yelk disappears, and the remaining fluid is either absorbed by the larva through the skin, or evaporates through the shell; the tracheæ become visible by getting filled with air, and the larva begins the process of eating through the shell."

Cecindelid Larvæ.—H. F. Wickham describes[8] the larva of Cecindela as "a somewhat elongate, whitish grub, with a broad, metallic colored head and prothorax, and a large hump, bearing two hooks, on the fifth abdominal segment. They excavate holes in sunny spots and lie in wait for prey, with the head closing up the mouth of the burrow; when an insect comes within reach, it is seized by the long jaws of the larva and the juices extracted. I am now rearing larvæ of *C. limbalis* Klug, which I dug from holes in a clay bank on the fifteenth of April. They are easily kept in little tin boxes with damp earth, and feed readily on soft-bodied larvæ of wood-borers. The pupa is figured by Letzner and is represented as bearing on the fifth abdominal dorsal, two spines corresponding to the hooks on the same segment in the larva."

Social Economy of the Hive Bee.—In a recent presidential address before the Biological Society of Washington, Dr. C. V. Riley described the social organization of the hive bee.[9] "Each bee," he said, "labors for the good of the commonwealth of which it is a member. Of them it might well be said:

Salus rei publicæ lex.

It is the welfare of the colony which directs the actions of all, and not the will of the queen. Indeed, it would seem that the latter performs her important function—that of supplying the hive with eggs—only when the workers will it, their own condition of prosperity as regards stores, or their anticipations of the future needs of the colony as regards population, causing them to supply the queen liberally with food rich in nitrogen—a partially digested substance, or a gland product, or perhaps, a mixture of both, which she alone cannot produce, yet without which any considerable production of eggs is an impossibility. As Evans remarks:

'The prescient female rears her tender brood
In strict proportion to the hoarded food.'

"We must, then, credit the industrious and provident workers with the chief influence in shaping the policy of the hive. They are the *servum pecus*—the living force—of the colony. And to the end that order and efficiency of effort may prevail, they have, we find, a marked division of labor. In the normal condition of the hive the young workers care for the brood—a labor which they take upon themselves

---

[8] Can. Entomologist, June, 1894.

[9] Insect Life, September, 1894.

within two or three days after issuing from the cell. The glands which secrete a part of the food required by the developing larvæ are active during the earlier part of the life of the worker. Later, these nurses become incapable of doing their work well as the gland system becomes atrophied. When a few days old they take short flights, if the weather favors, but seldom commence gathering stores before they are fifteen days old. Wax production is more essentially a function of the workers in middle life, and it is particularly noticeable that those bees fashioning the wax into combs are principally of this class. Many of those acting as foragers do, however, secrete wax scales, which are doubtless, in the main, utilized. Among the outside workers and hive defenders some bring honey only on certain trips or for a time, others honey and pollen, others water, and yet others propolis or bee glue to stop up crevices and glue things fast. Meanwhile, some are buzzing their wings at the entrance to ventilate the hive, and others are removing dead bees, dust or loose fibers of wood from the inside of the hive or from near the entrance, or are guarding this last against intruders, or perhaps driving out the drones when these are no longer needed."

Notes on New Hampshire Lepidoptera.—Mr. James H. Johnson, Pittsfield, N. H., in a letter to the editor of this department, recently, included the following notes on Lepidoptera in his region: "I have one specimen of *Colias interior* from Charlestown. This, I notice, Maynard calls 'accidental at Waterville, Me.' One specimen of *Debis portlandia* I took at Webster, one *Limenitis arthemis* (*proserpina*) at South Sutton, one *Thanaos brizo* and several of *Neonympha eurytris* at Charlestown. I have a pair of the *Chionibas jutta* from Orono, Me.

"Of the moths, I have one each of *Catocala relicta* and *C. relicta* (*bianca*) one pair of *Eacles imperialis*. These three were taken at South Sutton, Va. I find *Eucronia maia* is quite common in one place here at Pittsfield. Have not noticed it elsewhere. I see Dr. Harris called it rare in Mass."

Hemiptera of Buffalo.—One of the most valuable of recent faunal lists has just appeared in the Bulletin of the Buffalo Society of Natural Sciences (Vol. V, No. 4). It is "A List of the Hemiptera of Buffalo and Vicinity," by Edward P. Van Duzee. It "enumerates all the described Hemiptera to and including the Jassoidea known to inhabit the vicinity of Buffalo, N. Y. The limit of 70 miles, adopted by

Mr. David F. Day in his Catalogue of the Plants of Buffalo and Vicinity, has been followed by the author * * * but nearly all the species have been captured within a radius of 20 miles of this city." The Psyllidæ, Aphididæ and Coccidæ have not been included in the list which enumerates 378 species, and mentions 25 undescribed species that have been found.

In the same Bulletin Mr. Van Duzee publishes Descriptions of some New North American Hemipterous Insects, belonging to the following genera: Idiocerus, Platymetopius, Allygus, Deltocephalus, Athysanus, Entettix, Scaphoideus, Thamnotettix, and the new genera here characterized, Tinobregmus and Xestocephalus.

ARCHEOLOGY AND ETHNOLOGY.[1]

The Age of Certain Stalactites.[2]—The fact has been recognized for some time among scientists that the formation of stalactites, under favorable circumstances may take place in a relatively short time.

Nevertheless, observations upon the exact period required for the growth of given examples have been rather rare, for while there has been abundant opportunity to compute the age of stalactites at railway bridges and tunnels, the various dangers which beset these delicate growths in such places have generally put a considerable limit to their age, and deprived them of conspicuous size. It may, therefore, be of interest to state an instance where not only the time of growth but also the exact size of a stalactite can be given with absolute precision.

In the year 1873 the city of Bayreuth (Bavaria) built a reservoir for drinking water three kilometers southwest of the town. This so-called Lasser Reservoir is built in a *Keupersand* soil which contains exceedingly slight traces of lime. The water used in the basin comes out of the *Keuper*, (the uppermost of the three subdivisions of the Triassic period), and likewise contains lime, though in very small quantity. At the point shown in the illustration a spot on the ceiling of the arch (built across the tank to protect the water from pollution H. C. M.) stalactites of remarkable size had formed in 1893. Supposing that they had begun to form by the infiltration of surface water through the arch immediately upon its completion in 1873, they could not have been more than twenty years (1873–1893) old, and as the photograph recently taken from nature shows their length to be between 60 and 80 centimeters, they must have grown on an average of from 3 to 4 centimeters a year. The reservoir was first used in 1874, the tank under the arch remaining full of water until the present year, when in the course of the summer, the water was drawn off for repairs, and an opportunity afforded of observing and detaching some of the stalactites. A great number of the finest specimens were broken through the ignorance of workmen. In a damp walled chamber adjacent to, though not included in the area of, the basin, hung whole rows of stalactites from 20 to 30 centimeters long. These were extremely fragile and very difficult to remove without breaking.

---

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

[2] Translation from the original German.

A careful examination of the structure of the reservoir building showed that the stalactites must have formed as follows:

The reservoir's arched roof from which they hung was built of bricks laid in cement (probably the kind known in America as German Portland, H. C. M.). Slight fissures had formed in the cement through which the water of the surface (rain water H. C. M.) had trickled. This down trickling water had dissolved portions of the cement, and then evaporating, had first caused a formation composed of particles of lime dissolved from the cement. This formation was the starting point of the stalactites. On it had been precipitated very fine particles of the reservoir water, leaving after they had evaporated a further residuum of lime upon the already existent pendant.

This view is strengthened by the fact, that since the building of another more recent (so-called Fuchstein) reservoir 3 kilometers west of Bayreuth, stalactites 2.5 centimeters long have shown themselves hanging in the same way from the cement ceiling of the roofing arch. Moreover, if indentations are scratched in the cement, pendent accumulations of lime are soon formed, which, however, are not hollow in the middle like the stalactites.

Finally, as the result of an experiment, the following method for producing stalactites artificially, may be mentioned:

Take a common hectoliter cask. Make a hole in its bottom. Plug this hole with a wooden plug so wound with tow that the water may trickle through it in very small quantities. Around the end of the plug on the outside of the bottom of the cask, spread cement (German Portland cement, H. C. M.) in which a slight fissure should be left. Then fill the cask with the water containing lime in solution and place it in the open air. Hang a piece of tow on the fissure in the cement so that the water trickles upon it, and stalactites will form very rapidly. In this way I made a stalactite 5 centimeters long inside of 8 weeks.

FRANZ ADAMI.

Bayreuth, September 30, 1894.

Note by the Editor.—A very hard crust of stalagmite, covering a loam bed with rhinoceros teeth and human relics, overlaid the cave floor of Kents Hole (near Torquay, England) in which Mr. McEnery says (1825) that he found in no instance breaches or openings, "but one continuous plate of stalagmite diffused uniformly over the loam." Schmerling who (in 1832) used to climb down into Engis Cave (near Liege, Belgium) by a rope tied to a tree, and after a long crawl, stand in the mud to superintend by torchlight, workmen digging in a wet

hole, had to break through a stalagmitic floor hard as marble and cut five feet into a breccia nearly as hard, to find the famous skull now in the University of Liege.

But the presence of these crusts, though serving satisfactorily to separate diverse accumulations on cave floors one from another, is no longer regarded in Europe as evidence of the great age of relics so entombed.

In the Wyandot Cave (right bank of Blue River, 5 miles from its mouth in the Ohio, Crawford Co., Indiana) a hole has been artificially battered in the side of one of the innermost large stalactites called "The Pillar of the Constitution,"and it appeared from the observations of Professor Collet (Ind. Geolog. Survey, 1876–77–78, p. 467) and Mr. Hovey who found (as I did in June, 1894) granite pebble hammerstones lying in a mass of splinters near the hole, and Mr. H. W. Rothrock, who (in 1877–78) found besides hammerstones, a deer horn "pick" or prying tool, close by, that Indians had battered out the hole with the stone hammers to get fragments of carbonate of lime for some purpose (possibly trinket making) not yet determined.

A crust of stalactite 10 inches thick has since crept over the bruised edge of this unique quarry, and Mr. Hovey thought (Celebrated American Caverns, p. 139) that "at the known rate of increase, it must have required 1000 years for the wrapping to attain its present thickness of 10 inches, and that length of time has, therefore, elapsed since this 'alabaster' quarry was worked."

Professor Adami's above statement which omits, however, a chemical analysis of the cement referred to, is one of the sort of valuable observations which has shaken faith in the worth of all age tests based on stalagmite or stalactite. If for a thousand years the still standing forests have helped dampen the roof of Wyandot Cave, if rain has kept falling at an equal rate all that while, and if water always equally charged with lime has gone on trickling through the ceilings ever since, then what happened in twenty years to rain water and cement at Bayreuth might have taken fifty or a hundred times as long to happen to rain water and limestone in Indiana. But we can hardly imagine a case where in a cave care enough would have been taken, and time enough spent in measuring the yearly increment, or still more where the inferred conditions of uniformity reaching back into a little known geological past, could have been weighed.

H. C. MERCER.

Indians Mining Lead.—Mr. Benjamin Pursell, of Kintnersville, Bucks County, Pa., told me in September, 1891, as a well known story in the Delaware Valley, that Indians in the last century had shown members of the Ridge family, then living on Ridge's Island, lead ore in situ, at a spot never since discovered in the neighboring hills.

More definite still is the lead story of New Galena, Bucks County, Pa., at third hand. Somewhere in the middle of the century Elijah and Abraham Campbell, of Plumstead, told John M. Proctor, now of Blooming Glen, who wrote me in December, 1891, that straggling Indians coming to hunt along the north branch of the Neshaminy, between 1790 and 1808, had often taken them as boys to a place near the mouth of the "Hartyhickon" (now the property of Mr. Arthur Chapman). There they disappeared in the woods to return with their arms full of lead, with which they made bullets.

I took these for local tales till I was surprised to hear J. M. Kessler, at Hummel's Wharf, Snyder County, Pa., tell me the same story, while pointing to the hills across the Susquehanna as its scene. But I came nearest of all to the legend when Reuben Anders, of Little Wapwalopen, Luzerne County, Pa., gave me it first hand. He had seen the Indian who had spent the night with his grandfather and offered to show him a mineral wonder on a hill called Councilkopf. Though the latter was afraid to follow the red man alone, one Harman had gone hunting with two others, who when bullets had given out had gone into the woods and returned with loads of lead. If untrue, it is hard to see why this lead story has so seized the popular mind. But when we realize, as I am informed, that lead rarely, if ever, occurs pure in nature, but as galena, which, if mixed with lumps of limestone, requires about 1200 degrees (Centigrade) of heat to smelt by drying out the carbonic acid and removing the sulphur, it is to be doubted whether, given the galena, any such offhand bullet-making in the woods could ever have taken place.[3]

Squier and Davis found galena ornaments in ancient Ohio tumuli. Mr. Clarence B. Moore showed me a lump excavated by him from a St. John's River (Florida) mound, and modern Sioux ornament their catlinite pipes with lead, but no digging has yet proved that mound

---

[3] Some specimens of galena, recently obtained through Mr. Alfred Paschall, from the prospective mine now working in the bed of the North Branch of the Neshaminy, on the farm of Henry Funk (New Britain Township, Bucks County, Pa.), would not melt in a red-hot crucible, but splintered into fine fragments, as did other fragments when held directly in the bellows fire.

builder or Indian in pre-Columbian times regarded galena as other than a hard, glittering stone to be pounded or rubbed into trinkets.[4]

Still we know that the Rhode Island Indians very soon learned the art of pewter casting from Roger Williams' colonists, and the question therefore, is, had Indians in Eastern Pennsylvania by 1780–90 learned from white men how to smelt bullets from galena for their newly acquired guns?

Whether or not these lead tales furnish us with an archeological clue of importance, they seem less strange than the story told me on July 12, 1893, by Charles Keller (now 84 years old), of Point Pleasant, Bucks County, Pa., as related to him sixty years ago by his father, Christopher Keller. About the end of the last century Peter Keller, Christopher's brother, had refused to do some iron work for a band of Indians at his blacksmith shop, on Tohickon Creek, above Stover's mill (the present Redding Meyers farm,) about six miles above its mouth on the Delaware River. When he pleaded as an excuse that his supply of charcoal was exhausted, the Indians went into the forest and after nearly a day's absence returned with a basket full of "stone" (anthracite) coal, with which he did the job.

H. C. MERCER.

---

[4] After the present pages were written, Mr. Walter Chase, of Madison, Wisconsin, showed me a small figure of a turtle of cast lead found by him at a surface Indian camp site in 1889 on the shore of Lake Wingra, two miles southwest of Madison. Dr. Hall, of Madison, had another plowed up by a farmer in 1891, with a stone axe and four or five arrowheads, from an effigy mound shaped, itself, somewhat like a turtle, on the shore of Lake Mendota, near Madison. Two perforated discs of cast lead have also been found by farmers in Dare County, Wisconsin, and are now in the possession of neighboring collectors. Galena occurs in Southern Wisconsin in small, loose masses in a very pure state.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History, November 7.—The following paper was read: Professor George Lincoln Goodale, An account of the Ware Collection of Blaschka Glass models of Flowers in the Harvard University Museum. With illustrations.

November 21st.—The following paper was read: Dr. George A. Dorsey, "The Peruvians, prehistoric and modern." Stereopticon views were shown.

SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences, Biological Section, October 22.—The following papers were read: Professor N. L. Britton, and T. H. Kearney, Jr., "On a Collection of Texano-Mexican Plants,"—new species and altitudinal notes; Professor E. B. Wilson, "The fertilization and polarity of the egg in *Toxopneustes lividus.*" The study of extensive series of sections fixed by sublimate-acetic and stained by Heidenhain's iron-hæmatoxylin fails to give any evidence of a "quadrille of the centrosomes." The archoplasm is wholly derived from, or formed under the influence of a substance derived from the spermatozoon and situated not at the apex but in or near the middle-piece. Regarding polarity, the continuous observation of a large series of living eggs shows that the definitive egg-axis has no constant relation to that passing through the excentric egg-nucleus but may form any angle with it. The first cleavage passes approximately through the point of entrance of the spermatozoön as described by Roux in the frog. Dr. Bashford Dean, "On the breeding habits of Lepidosteus from observations at Black Lake, N. Y., May, 1894;" Professor H. F. Osborn, "On the Proceedings of the Biological Section of the British Association."

November 12.—N. L. Britton, "Problems in Plant Evolution," noting from the side of Paleobotany the centralized position of Algæ and the probable affinities of pteridophytes and bryophytes. G. N. Calkins, "A little known phenomenon in the life history of *Stentor coeruleus.*" The free swimming Lieberkuhnina of Bütschli was shown to be (as Claparède and Lachman had earlier believed) an embryo *Stentor.* H. G. Dyar, "A classification of Lepidopterous larvæ according to setiferous tubules," giving data for the establishment of six